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THE SCIENTIFIC ENQUIRER:

A MONTHLY MEDIUM FOR THE SUPPLY OF INFORMATION ON ALL

Scientific Subjects.

EDITED BY

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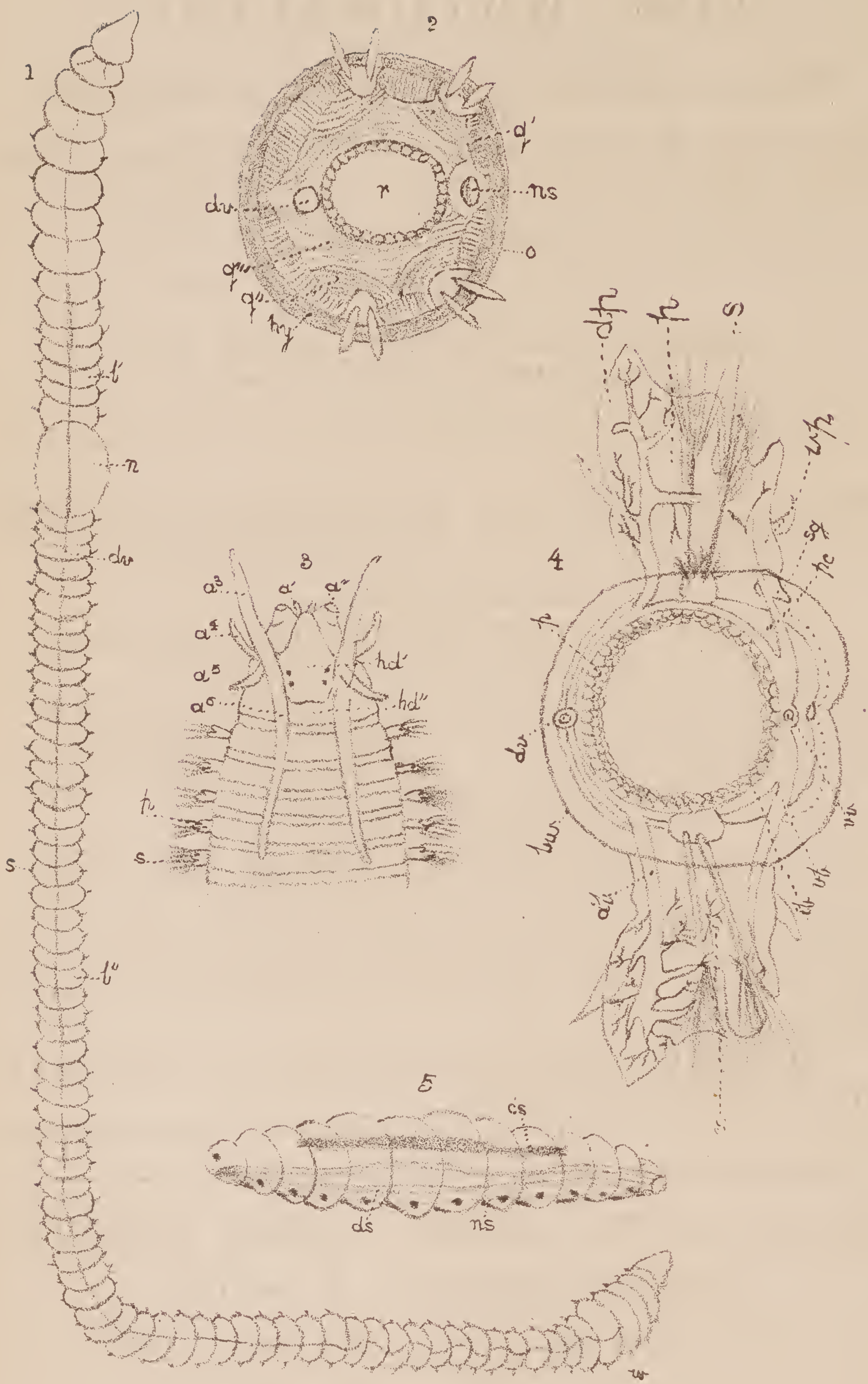


Earth Worm and Nereis

The Scientific Enquirer.

JANUARY, 1887.

The Study of Worms.*

Chapter I. The Common Earth-Worm.

By Alpheus Hyatt.

Plate I.

TO obtain the most satisfactory results with the earth-worm, living specimens should be placed in a deep soup-dish filled with fresh water. Abundant moisture is necessary to these worms; indeed, they cannot breathe freely unless their skin is damp, so that this treatment is not so cruel as it seems. It will be noticed that the body is long, cylindrical, and divided into rings or segments. The number of segments cannot be easily ascertained in the living animal, but in prepared or alcoholic specimens from one to two hundred may be counted, the number varying with the size of the worm. The deeper constrictions which form the rings are supplemented, in this creature, by shallower folds, or false constrictions, encircling the body, and dividing the surface of each true ring into two parts. These are mere skin folds, and, therefore, in counting the number of rings, it must be borne in mind that the true rings are only half as numerous as the apparent number of rings. It should be next observed that this segmented body is divided into three parts. The anterior portion (Pl. 1, Fig. 1, *l* 1) tapers to a blunt point, and has the largest rings. The thickened middle portion (Fig. 1, *n*) is known as the "clitellum" or "saddle." The posterior part (Fig. 1, *l* 2) consists of segments of nearly uniform size, excepting a few at its extreme end, which are broader and flatter (Fig. 1, *w*).

A thin, tough cuticle, composed of the peculiar substance,

* From "Guides for Science Teaching," published by Messrs. Ginn, Heath, & Co., Boston, U.S.A.

chitine, similar in appearance to horn, covers the whole body. This may be easily removed from alcoholic specimens which have lain in water two or three hours.

The brownish-red colour of the exposed back of the worm, and the paler hue of the belly, should be observed, together with the beautiful iridescence of the cuticle. This iridescence is due to the breaking up of the rays of light by reflection from the many fine ridges running parallel to each other, and which may be observed by putting a piece of the cuticle under the microscope. These are really minute folds of the transparent, outer skin, and can be made to flatten out and disappear by stretching the specimen. The iridescence, at the same time, vanishes, proving that the brilliant play of colours is wholly due to the mechanical, file-like structure of the surface upon which the light falls.

The intestine can be seen as a dark streak in the interior, extending the whole length of the body, and opening through the last segment. Lying above the intestine is the blood-vessel, known as the pseudhaemal vessel (Fig. 1, *dv*). This runs along the middle of the back above the intestine, like a very narrow red thread. It becomes apparent only during the pulsations when the tube is gorged with red fluid. This is regarded by most authors as distinct from the white blood which is found circulating in the cavities of the body, but not inclosed in special vessels. The vessels are, however, similar to the circulatory vessels of other animals in position and function, and can be properly spoken of as the circulatory system.* The student will observe that the first segment of the body is pointed, forming a sort of upper lip for the mouth, which is immediately below. This mouth leads into a pouch, which is sometimes turned outwards, and becomes what is called a proboscis for the purpose of taking food.

If the worm is turned upon its side, or closely observed from above on a white plate, short hairs, or setæ, as they are called, will be seen projecting from the surface (Figs. 1, 2, *s*). Place the animal on moist earth, and watch it closely; it will then be seen that these setæ are used, upon such soft or uneven surfaces, to aid in the act of crawling; but if the earth-worm be placed upon a pane of glass, or in a smooth dish, it will be found that, in spite of their number, the setæ are not suitable for moving the worm upon such hard and smooth surfaces.

When partially-dried or alcoholic specimens are examined with

* The white fluid of the visceral cavity is generally considered as the nutritive fluid, and as comparable in its structure to the blood of the Crustacea, which circulates in a circuit comprising vessels opening into the visceral cavity, and the cavity itself. The worms, therefore, have two fluids to perform the two main functions of the blood in place of one combining both these offices, as in other animals.

a lens, two double rows of these short hairs are observed on either side. One of the rows is seen just where the dark-red colour of the back fades into the lighter tint of the ventral surface, while the other is nearer the median line. Every segment, excepting the first, second, third, fourth, and last, has four pairs of these setæ. They are unjointed, and, in alcoholic specimens, as a rule, project forwards, so that when the worm is drawn gently through the fingers from the head to the tail, the resistance offered by the stiff hairs is very sensibly felt.*

The setæ extend a short distance into the interior of the body; and here there are muscles which move them forwards and backwards, like a double set of short crutches, when the animal crawls.

If the ninth, tenth, and eleventh segments of an alcoholic specimen are examined, they are seen to be much larger than the other anterior rings, and to have glandular swellings on their ventral surfaces. Four openings may also be observed between the ninth and tenth, and tenth and eleventh segments; these are in a line with the outer row of setæ, and are the four apertures of the seminal receptacles. On the fourteenth ring, just outside the inner row of setæ, are the two minute openings of the oviducts; and on the fifteenth segment the large, slit-like apertures of the seminal ducts may be observed. The earthworm is, therefore, an hermaphrodite, though self-impregnation does not occur. In the months of July and August pairing takes place, when each worm fertilises the eggs of the other.

Along the middle of the back a row of pores may be detected by close examination, one in each segment, with some few exceptions, which lead into the body cavity.

In the earthworm there are no specialised breathing-organs, but aëration of the blood is effected through the whole skin. The sense-organs are also wanting, though the animal is susceptible to light-impressions, as may be easily proved. A few worms may be kept in a pot of damp earth, and when the room is dark they will come to the surface; but let direct rays of light fall upon them, and they will hastily retreat. According to Hoffmeister, these light-impressions are only received by the first two rings.

If a cross section of the body of the worm is made, the relative position of the internal organs may be seen. Fig. 2 represents such a section.

Beneath the thin, outer cuticle (Fig. 2, *o*) there lies a thicker,

* This is contrary to Huxley, who states that the resistance is felt when the worm is drawn in the opposite direction, or from the tail to the head. After the death of the worm, the setæ may become fixed either way, being directed forwards in some parts of the body, and backwards in others; though, in the specimens examined by us, by far the greater number projected forwards.

transparent, and cellular layer known as the hypodermis (*hy*). Internal to this layer are bands of circular muscles, which extend continuously around the body of the worm (*g* 1). These bands are underlaid by five thicker bands of longitudinal muscles, which run the length of the body (*g* 2). Muscular septa extend inwards to the intestine, dividing the body cavity into separate chambers for every segment, except a few in the anterior part (*g* 3).

s is one of the eight setæ which are developed in sacs, and pass outward. Above the intestine (*r*) lies the pseudhaemal vessel already described (*dv*), and below it the nerve cord (*ns*), which runs along the floor of the body.

Having become familiar with the essential structural characters of the earthworm, we will now consider its habits, and the work it performs.

The coiled castings which lie upon the worm-holes are familiar to everyone. These are due to the fact, that the earthworm, in digging a new hole or deepening an old one, swallows the earth, and passes it through its intestine. This is also one of its methods of obtaining food, since more or less organic matter is contained in all the soils which are frequented by them.

For several years Von Hensen watched these humble animals, and the account he has given us is exceedingly interesting.* According to this observer the worms in the night, and when the weather is damp, come to the surface, and draw leaves, twigs, or the seedlings of plants into their holes. These holes run almost vertically downward from the surface to the depth of three, four, and even six feet. Upon close examination, Hensen found that the worms usually roll the leaves together singly, and draw them into the opening of their holes with the petioles pointing towards the surface. The buried parts of these, thus drawn into the holes to the depth of one or two inches, soon become softened, and in a partly decomposed condition are eaten. In this way the earthworm obtains sufficient food without the assistance of teeth, or hard jaws; solely by the aid of the suctorial power of its proboscis. The deepest part of the hole is thickly set with stones of the size of a pin's head, which are placed there by the worm itself, and when such stones cannot be found, the seeds of early fruits are chosen. In December several seeds which had sprouted were found in one hole. The delicate rootlets of other plants also often run through the whole length of the holes, forming beautiful webs along the walls. Darwin's last remarkable book† throws still more light upon this subject. It is here shown that worms have accomplished an almost incredible amount of work in forming the soil,

* See "Zeitschrift für Wissenschaftliche Zoologie." Vol. XXVIII.

† "Vegetable Mould and Earthworms," 1881.

and preparing the layer of vegetable mould which covers the surface of the land to a greater or less depth in every moderately humid country. This mould might, in some respects, be called worm or animal mould, instead of the usual term "vegetable mould," inasmuch as it "has passed many times through, and will again pass many times through, the intestinal canals of worms." "In many parts of England," says Darwin, "a weight of more than ten tons of dry earth annually passes through their bodies, and is *brought to the surface* on each acre of land." While within their bodies even dry, sandy soil is converted by chemical agencies, trituration, etc., into rich, fine humus.

Stones, fragments of marl, cinders, etc., lying upon the surface of the ground, are, in time, covered by the castings of these animals. In this way the remains of many ancient buildings have been buried and preserved. On the other hand, massive walls have been undermined by worms, and, as a consequence, have subsided.

By other experiments it is shown that these animals are only able to distinguish light from darkness, are completely deaf, and have only the sense of touch well developed. Notwithstanding these facts, they exhibit a surprising degree of intelligence in plugging up the openings of their holes or burrows. "They act in nearly the same manner as would a man, who had to close a cylindrical tube with different kinds of leaves, petioles, triangles of paper, etc., for they commonly seize such objects by their pointed ends." . . . "They do not act in the same unvarying manner in all cases, as do most of the lower animals; for instance, they do not drag in leaves by their foot-stalks, unless the basal part of the blade is as narrow as the apex, or narrower than it." In conclusion, Darwin remarks, "It may be doubted whether there are many other animals which have played so important a part in the history of the world as have these lowly-organised creatures."

Short Papers and Notes.

Cutting, Staining, and Mounting Vegetable Sections.

By B.Sc., Plymouth.

As a contribution towards fulfilling Mr. Brokenshire's request, contained in your November issue, permit me to send you the following notes on vegetable section-cutting, staining, and mounting.

Softening.—If required, cut the specimen in short lengths, and steep in water for a few days, then for a short time in methylated spirit, the object being to dissolve out soluble and resinous matter. If not yet soft enough to cut, soak in hot water.

Embedding.—This is not always necessary. In the example proposed by Mr. Brokenshire, the stem of dog-rose should be taken in the hand, and cut with a razor, as detailed further on; but for softer material bedding in paraffin makes the cutting operation easier. Make a paper mould, by wrapping it round a ruler, closing it up at the end by folding in the paper, pour in melted paraffin, and hold the object in position by a pair of fine pincers until the paraffin gets cool. For hard, delicate objects, split up a piece of pith, insert the object, and cut with razor, or microtome; for soft objects, a piece of liver, which has been hardened in methylated spirit, suits well for a bed. There are still softer kinds of vegetable tissue, which cannot be cut without freezing, but into this branch I will not enter at present.

Cutting.—This is the only difficult manipulation of the series. In the German Histological and Botanical Schools, no one is allowed to use a microtome until he has become an expert in the use of the razor, and I think all microscopists should make the same rule for themselves. Here is the process, so far as I can explain it; but practice, practice, and again practice, is the only way to gain capability in the art. The razor best adapted for section cutting has a large, heavy blade; some prefer the ordinary English grind, some get the lower side of the blade ground perfectly flat; for my own part I prefer the hollow ground, because of its fine edge. A section-cutter must learn also to keep his razor very sharp; for this purpose keep a strip of thick Russian or buff leather at hand, and strop the razor often. Hold the object to be cut (in its bed) in the left hand, between the forefinger and thumb, and bring up all three perfectly level, until they are in the best position to suit the eye and the play of the elbows of the

cutter. Then take the razor (opened up to a V position) in the right hand, and enter it at the heel on the object to be cut, draw it to the right and inwards with one stroke, using the forefinger and thumb of the left hand as a rest for the razor. At every cut dip the razor into a tumbler of weak alcohol and water, kept at the right hand, and when two or three cuts still remain on the razor remove them with a pair of fine pincers into the alcohol and water. An expert cutter will be glad if one-half his cuts are transparent enough to mount. Examine while on the tumbler, throw away the thick ones, add more alcohol, and proceed to bleaching.

Bleaching.—Never bleach if it can be avoided; it takes away the protoplasm. Where required for transparency, soak the specimen in Labarraque's solution (dry chloride of lime, 100; carbonate of soda, crystallised, 200; water, 4,500. Dissolve the lime in ⅔rds, and the soda in ⅓rd of the water, mix and filter), keep covered until it is bleached, *but no longer;* wash again and again until all the Labarraque is removed, then wash in slightly acidulated (nitric) water, then in pure water, then in water and alcohol, then in almost pure alcohol, where it remains until thoroughly transparent. Leaves may be bleached before embedding.

Staining.—Double staining is most useful in differentiating the tissues. I will, therefore, state how I succeeded in it, and when a beginner has learned to double stain he will have no difficulty in single staining. With the pincers lift the cut from the alcohol and lay it on pure blotsheet to drain, then immerse it in a *very, very weak* alcoholic solution of iodine green. Let it remain for 24 hours (at the end of 12 hours it will probably have absorbed all the green, if so, add two drops of the strong solution); then place watch-glasses, or porcelain saucers, in the following order:—1, water; 2, ammonia carmine (Beale's formula is very good); 3, alcohol; 4, alcohol; 5, alcohol; 6, alcohol (pure); 7, oil of cloves. Take the cut from the iodine green, wash for a second in No. 1, transfer to No. 2 (carmine), say for 3 to 20 seconds, transfer to No. 3, where it remains only long enough to wash away the unfixed carmine, then pass it through the rest 15 minutes each; it is now ready for—

Mounting.—Clean slide and cover-glass thoroughly. Take two or three drops Dammar lac (thinned with turpentine), or Canada Balsam (thinned with chloroform). Put it on centre of slide, with a clean glass rod, take section from clove oil, arrange it on centre of Dammar with needle points, add another drop or two of mountant; then lift the cover-glass with the pincers, and holding it at an angle of 45° put the left side on the slide (on the top of the cut and mountant), hold this in place with the needle,

and gradually lower the right hand until the cover is flat; this is to exclude the air-bubbles. Clamp with a wire clamp, label it, and put it sloping in the sunshine till the remaining air-bubbles have gone, then lay aside in a drawer for a month or two until it hardens. Some ring with brown cement (shellac in spirit), but it is unnecessary.

For single staining, Hæmatoxylin is, in my opinion, the most useful. It is permanent, and almost any shade can be obtained. If overstained, place the object in a spoonful of alcohol, and put in a drop or two of Bichloride of Tin. In a second or two the colour will be reduced. Don't let it remain long. Although the double staining indicated above is now an old process, it is right to mention that it was first indicated to me by my friend, Professor Rothrosk, botanist to the U.S. Survey.

Cimex Lectularius.

The *American Architect* states that the Southern Pine seems to be the natural habitation in America of the *Cimex lectularius*, which is found in immense numbers under the bark of old trees of that species. If, it adds, the wood contains natural clefts, the insects and their eggs remain in these after sawing, and are often carried in that way in the seams of large timbers into buildings. Houses standing near living trees of yellow pine are sometimes kept infested with the vermin, which stray in all directions from their homes.

A Remarkable Tree.

One of the forest curiosities of the Isthmus of Darien and lower Central America is the tree-killer (*Matapolo*). This starts in life as a climber upon the trunks of large forest trees, and, owing to its marvellously rapid growth, soon reaches the lower branches. It then begins to throw out many shoots, which entwine themselves all around the trunks and branches, and also aërial tendrils, which as soon as they reach the ground take root. In a few years this gigantic parasite will completely envelop the trunk of the tree which has upheld it, and kill it. The whole of the inner dead tree will then rot away, leaving the hollow *Matapolo* standing alone and flourishing. This "tree killer" is a *Ficus.—Manufac. Gazette.*

The Action of the Heart.

As with each stroke the heart projects something like six ounces of blood into the conduits of the system, and as it does so

some 70 times every minute, and 4,200 times in an hour, this implies that it does the same thing 100,800 times in 24 hours, 30,000,000 times in a year, and more than 2,500,000,000 times in a lifetime of 70 years. The mechanical force that is exerted at each stroke amounts to a pressure of 13 pounds upon the entire charge of blood that has to be passed onward through the branching network of the vessels. According to the lowest estimate that has been made, this gives an exertion of force that would be adequate, in another form of application, to lift 120 tons one foot high every 24 hours. Yet the piece of living mechanism that is called upon to do this, and do it without a pause for three-score years and ten, without being itself worn out by the effort, is a small bundle of flesh that rarely weighs more than 11 ounces. It is in the nature of the case, also, it must be remembered, that this little vital machine cannot be at any time stopped for repairs. If it goes out of order it must be set right as it runs. To stop the beating of the heart for more than the briefest interval, would be to change life into death. The narrative of what medical science has done to penetrate into the secrets of this delicate force-pump, so jealously guarded from the intrusion of the eye that it cannot even be looked into until its action has ceased, is, nevertheless, a long history of wonders. By means of the sphygmograph—a writing style attached to the wrist by a system of levers and springs—the pulse is made to record actual autographs of cardiac and vascular derangement.—*Bos. Jour. Com.*

The Limit of Thinness.

In a recent lecture before the Franklin Institute, Mr. G. E. Outerbridge, jun., said :—The gold-beater will hammer the metal into leaves so thin that more than 4,000 are required to make a pile one millimetre in thickness. But vastly thinner gold leaves may be obtained in another way. By electro-plating a known weight of gold upon one side of a sheet of copper foil of given dimensions, a coating of gold may be obtained upon the copper, whose thickness is readily ascertainable by a simple calculation ; then by using a suitable solvent the copper may be removed, when the leaf of gold will remain intact. After a series of careful experiments, I have obtained in this way sheets of gold, mounted on glass plates, which are not more than 1-40,000 of millimetre in thickness ; and I have some specimens to show you, which I have good reason to believe are not more than the 1-400,000 of a millimetre thick. To give you some idea of this thickness, or rather thinness, I may say that it is about 1-200 part of the length of a wave of light. Taking Sir William Thompson's estimate of the size of the final molecules, and considering that each layer (of

molecules) corresponds to one page of a book, our thinnest film would then make a pamphlet having more than 100 pages.—*Chemist and Druggist.*

An Inch of Rain.

Few people can form a definite idea of what is involved in the expression, "an inch of rain." An acre is equal to 6,272,640 square inches; an inch deep of water on this area will be as many cubic inches of water, which at 277·274 to the gallon make 22,622·5 gallons. This quantity weighs 226,225 pounds, or 100·93 tons. One hundredth of an inch (0·01 inch) of rain is equal, therefore, to one ton per acre.

How a Star is Weighed.

The power we have of weighing a star is, without doubt, one of the most surprising results of the advancement of the sciences, that one, indeed, which persons unacquainted with the principles of celestial mechanics most hesitate to accept. To weigh a star is a fact more extraordinary again, than to measure the distance of one; and certainly neither Copernicus, nor Galileo, nor Kepler, nor Newton could have imagined that the day would come when their successors would be able, by the application of their immortal discoveries, to determine the mass of a star lost in the depths of celestial space. Let us attempt to give an idea of the method employed in acquiring a knowledge of the magnitude and masses of stars.

The mass of a star is calculated by the energy of the action that it throws around it. If the earth were ten times heavier than it is, still preserving the same volume, it would draw bodies toward its surface ten times more forcibly than it now does, and an object which now falls a given number of feet in the first second of time, would then drop ten times that number of feet in that second. Again, if the earth, still preserving its volume, had the mass of the sun, it would attract bodies with an energy increased 324,000 times, and an object which now weighs one pound would then weigh 324,000 pounds; a man of the mean weight of 160 pounds would weigh 51,000,000 of them! We measure the weight of a star by the intensity of the attraction to its surface. Reduced to its simple expression, in its application to the fall of bodies, this attraction would be difficult to verify; but we can determine it by the velocity of a satellite gravitating around a star whose mass we wish to know.

For example, the attraction of the earth has the power of curving the straight line which would be followed by the moon in

space if this attraction did not exist, and it bends the line by its attraction in such a way that the moon runs round the circumference of a circle in twenty-seven days, seven hours, and forty-three minutes. If the mass, or the energy of the earth, should increase, the velocity of the moon in its orbit would also be augmented; if the mass should be diminished, the contrary effect on the moon's orbit would be produced. Attraction varies in the direct ratio of the masses. The velocity of the moon around the earth comes from this same force of the earth. The earth is the hand which causes the moon to turn in the sling. If the earth had more force, more energy than it really has, it would cause the moon to turn more swiftly, and *vice-versa*. If the sun should increase in weight, the earth and the other planets would turn more rapidly around it, and years would decrease in length. If the mass of the sun should decrease, the contrary results would take place. By comparing the action of the sun on the earth with the action of the earth on the moon, we have found that the sun is 324,000 times more energetic, more powerful, more heavy, than the earth.

If, then, we had in space a celestial couple, of which the mutual distance of the two components were equal to that which separates the earth from the sun, or 91,500,000 miles, the examination of the duration of its revolution would give us immediately the mass of the system as compared with that of the sun. Mathematically speaking, if a couple of celestial bodies turning around their common centre of gravity employs a certain time, T, to accomplish its revolution, while another pair, whose components are the same distance from each other, employs another time, D, to accomplish its revolution, the mass of the first pair is to the mass of the second in the inverse ratio of the square of the times —that is, as D^2 is to T^2. If the distance is not the same, it is necessary first to reduce it to this equality, in taking account of the law which governs distances—"The squares of the periodic times are to each other as the cubes of the distances."

In this way Camille Flamarrion, the eminent French astronomer, has been able to calculate the mass of the stellar system of the double star 70 (Rho) Ophiuchus. By a combination of all the observations, he found that the period is 92 years and 283 days. The parallax of the star, being $0''\cdot168$, corresponds to a distance from the earth equal to 1,400,000 times that of the sun. At this immense distance, the radius of the terrestrial orbit being reduced to the preceding angle, the semi-major axis, of $4''\cdot88$, represents 2,687,000,000 of miles. This is a little less than the distance of Neptune from the sun. A planet situated at this distance from the sun would accomplish its revolution in 156·55 years. The ratio then is the square of 156·55 to the square of

92·77, or as 2·85 to 1; from which it is concluded that the mass of the system of Ophiuchus is almost three times greater than that of the sun and of Neptune combined, or (Neptune having only a small relative mass) three times greater than that of the sun alone. Thus a star has been found, hardly visible to the naked eye, which weighs 900,000 times more than the earth.

It may be here remarked that the orbital motion of the little star around the large one is about 519,000 miles per day, and that these twin suns travel together across immensity with a velocity whose minimum is 615,000,000 of miles per year. And these are among the heavenly bodies which are still called fixed stars.

Calculations made on other stars lead to similar results, presenting to us these celestial torches as gigantic and ponderous stars, which the enormous distance that separates us from them reduces to simple mathematical points. The star nearest to us, Alpha of Centaurus, has a parallax of 0″·91, and, therefore, its distance from the earth is about twenty trillions of miles. If we adopt 15″·5 for the mean value of the angle comprised between the two components, their mutual distance is found to be about 1,675,000,000 of miles. This is less than the distance of Uranus from the sun. But its period appears to be about 77 years. We infer, then, that it weighs a little less than our sun, and that representing its mass by 10, that of the sun would be represented by 12. But its volume should be larger (that is, of the two united suns), for its intrinsic light is about three times superior to that of our sun. If quantity of light is regarded as a criterion of the surface of emission, the diameter exceeds that of the ratio of 17 to 10.

The period of Eta of Cassiopeia, which at first was valued at 700 years, is now fixed at 176, and it is probable that this figure does not vary much from the truth. Allowing the parallax of 0″·154, which gives a distance of 132 trillions of miles and a semi-major axis of 10″·68, the mass of this system exceeds that of the sun ten times. It may be concluded, therefore, that double stars are veritable suns, immense and mighty, governing, in the parts of space lighted by their splendour, systems different from that of which we form a part. We infer that the sky is not a gloomy desert; all its regions may be peopled like those in which the earth happens to be located; obscurity, silence, death, once regarded as reigning in far-off distances, have given place to light, motion, and life; thousands and millions of suns pour in vast waves into space the energy, the heat, and the diverse undulations which emanate from their fires. All their movements follow each other, interfere, contend, or harmonise in the maintenance and incessant development of different organisations of universal life. How different the universe from that contemplated previous to the

development of modern astronomy! Suns succeed suns, worlds succeeds worlds, universes succeed universes. Tremendous movements carry all the starry systems across the endless regions of immensity, and everywhere, even beyond the farthest limits to which the imagination has carried its weary flight—everywhere, divine creation shows itself in infinite variety, and our microscopic planet is one of its minutest provinces.—*Professor Paul A. Towne, in N. Y. Home Journal.*

Flukes in Liver of Frog.

J. W. Gifford will find notes on the above in *P. M. S. Journal*, Vol. II., pp. 251, 252, where the cavities of frogs, snails, fish, and mussels are given as the abode of (1) opalinæ, (2) cercariæ, and from them (3) the liver fluke. A. East.

Development of Fleas.

By way of supplementing the article on page 209 of Vol. I., I would suggest that the easiest way to get eggs, larva, and pupa of fleas is to take a mat, or bed, on which a cat or dog sleeps, and shake it over a sheet of paper. I have found abundance in the summer in this way. The larvæ are said to feed on the parent's excreta, but probably more correctly on half-digested blood, prepared by the parent for the nourishment of the offspring. There are two admirable articles on the anatomy and internal structure of the flea, by Mr. W. H. Furlonge, in *Quekett Journal*, Vol. II., pp. 184 and 189, and Vol. III., pp. 12—31; see also *Science Gossip*, Vol. I., p. 278, and Vol. III., p. 47.

H. E. Freeman.

M. Pasteur.

M. Pasteur's latest communication to the Academy of Science, on his researches into the cure of hydrophobia, is the most thorough answer that he has as yet given to his calumniators. It fairly bristles with carefully-composed statistics, and names, dates, and facts are given with unquestionable authority. He states that, since his experiments were first tried on human beings, 2,490 persons have been inoculated at Paris; and that of these 80 were from England, 2 from British India, 18 from the United States, and so on—the largest number, viz., 191, being from Russia. Out of 1,700 French persons who were treated 10 died, but M. Pasteur proves, by statistics furnished by mayors and others, that a very small minority of people who were bitten during the year 1885-6, in France, did not come to him for treatment, and that of these 17 died of hydrophobia. In the Paris hospitals the

mortality from hydrophobia was 11 per annum for five years. Last year the number was 21, but since November, 1885, when the Pasteur system was introduced, only two persons have died, and these had not been inoculated. One died after inoculation, but his treatment had been under the old system of mild injection. Most of those who underwent the mild treatment were children who had been bitten severely in the face, and it was only after a sad experience that the necessity for stronger injections was made evident. At present, in cases of severe bites in the head or face, inoculations of a more intense kind—that is to say, composed of virus freshly extracted—are used. Alluding to the deaths of the three Russians from Smolensko, M. Pasteur persisted in his belief that the other sixteen were saved by being subjected to more intense treatment after the deaths had proved that mild injections were useless in cases of the kind. Referring next to his new experiments in inoculating animals with rabies, M. Pasteur said that the rabbits were now vaccinated as soon as possible after inoculation, and then re-vaccinated, so as to test the result. He thought that Dr. Frisch, of Vienna, must have failed in his experiments owing to the long intervals between inoculation and vaccination, as the results obtained by himself from the new system were highly satisfactory. The reading of M. Pasteur's long report was received by the members of the Academy with their customary enthusiasm.—*Daily Telegraph.*

Answers to Queries.

137.—Picro-carmine.—Water and alcohol dissolve out the picric acid, and hence remove the yellow colour from sections stained with this agent. The after-staining processes should be gone through as quickly as possible, and the specimen mounted in glycerine, containing 1 per cent. formic acid, which appears to increase the differentiation of the stain.

Picro-carmine bought ready-made is seldom of much use.

A. W. L.

137—Picro-carmine.—After having stained the sections as required, place them in water acidulated with a few drops of acetic or picric acid, and leave for an hour. The former is, I think, the best of the two acids. When making experiments in treble-staining a number of sections, stain picro-carmine, then place in methylated spirit; there they may remain until required, as the spirit does not affect the stain, which forms a very good ground colour on which to try combinations of different anilines. The second

method is as follows :—Lay the section out flat on the glass slip, drain off the superfluous water, and run several drops of the staining fluid (not diluted) over it ; allow to stand for from three to five minutes exposed to sunlight, covered with a watch-glass to keep off the dust. (In winter it is well to warm gently, over a spirit-lamp, the slide on which the section is being stained, as slight heat causes the tissues to stain both more rapidly and more brilliantly). Do not wash the section, but simply run off the superfluous fluid by tilting the slide, and then wiping round the section with the thumb, or a very soft, clean cloth ; but be careful not to remove the whole of the staining fluid, as any slight excess is gradually taken up by the tissues after the section has been mounted in either Farrant's solution, or glycerine, to which from one to five per cent. of formic acid has been added (C. Balsam, or Dammar may be used, though some think that it spoils the section). The full effects of the stain are not always seen at first, but after the section has been mounted for two or three days, especially if a small quantity of the staining fluid has been left on the section, a beautiful selective double stain is found. There are many other methods which are but slight modifications of the two here given. For further notes see *P. M. S. Journal*, Vol. V., 1886. V. A. LATHAM.

137.—Picro-carmine.—Place the sections, say vegetable, in alcohol for one hour ; immerse them in the (recently filtered) staining solution for from half-an-hour to three hours ; *i.e.*, until they are sufficiently stained. Wash them in alcohol, immerse them in an alcoholic solution of picrate of ammonia for one hour, and for a second hour in a like solution ; *i.e.*, change the solution once during the two hours. Place them in alcohol for a few minutes, and then place in oil of cloves for a short time and mount.—[From *Cole's Methods of Microscopical Research*, Part XI., June, 1884.] V. A. L.

139.—Origin of Jet.—I believe it is yet undecided as to what is the nature and origin of jet. Many chemists seem to think that it is a kind of bituminous wood or lignite. Others say it is a kind of indurated carbon. It is found in the Upper Lias of the Yorkshire strata, and in Spain. There was an article in *Science Gossip* for 1871, but I do not agree with the statement, that it is a kind of resin pitch origin. A slide viewed under the microscope (low power) shows "*woody* structure." It is also considered by some as a species of amber, and most probably had its origin from the exudation of some tree, as no doubt it is derived from vegetable matter. In Prussia it is generally called "Black amber," and occurs in nodules and lumps in lignitic strata, and found in great abundance in the cliffs of alumshale on the coast of Yorkshire, where the well-known jet manufactories of Whitby

and Scarborough are situated. Like amber, it is electric when rubbed; is more resinous in lustre than the finest Cannel coal, and is also specifically lighter. It does not show by a microscopic examination anything to indicate that it is fossil-wood, as it has not a woody texture like lignite, but is uniform like asphalt. Its intense velvety black well adapts it for the numerous ornaments into which it is manufactured. V. L.

142.—Paradise Tree.—A query, word for word the same as this, and signed with the same initials, "F. S.," appeared last year at page 69 of *Science Gossip*, and was answered in succeeding numbers, at pages 95 and 118. H. W. LETT, M.A.

144. — Diatomaceous Material.—Professor H. C. Smith's method of boiling in soap and water; then let the diatoms settle, and pour off the water is the best. The polishing powder found at grocers—electro-silicon—is often full of diatoms.

H. L.

146.—Telescope Lenses.—Probably the stain is where the glasses are joined together by Canada balsam; if so, separate by steeping in warm turpentine, and then clean. If that does not do steep in muriatic acid. B.Sc., Plymouth.

148.—Tortoise.—Slugs appear to be a favourite dish, because in this part of the country tortoises are sometimes put into gardens in order to eradicate this pest. White's Natural History of Selborne contains notes on the land tortoise, which will be useful to the querist. B.Sc., Plymouth.

151.—Talc, or Mica, is largely used by workers in polarised light, good specimens of the mineral being easily split into thin films of uniform thickness, and cut into any shape desired. In conjunction with selenite it is used to form the beautiful figures after Norremberg, to be viewed by convergent polarised light, as described by Mr. Lewis Wright in his book on Light. He also describes how artificial quartzes can be built up with mica films, which give a perfect rotation of colours, right or left-handed, according as the films are arranged. H. E. FREEMAN.

152. — Continuous Observation of Micro-Fungi. — What "G. H. L." requires is a damp-box, so-called, wherein to keep the slides when not in process of examination. This is how we made them in Strassburg laboratories:—Buy a round glass cover, same as used in bakers' shops to cover biscuits with, then get a soup-plate wide enough in the bottom to let the cover rest thereon, melt paraffin or tallow, and pour a layer on the bottom of the plate. When cool pour in water to the depth of $\frac{3}{4}$ inches. Cut a piece of sheet-glass round $\frac{1}{4}$ inch less in diameter than the cover.

Cement on this four common corks to act as pillars, and on this sheet-glass rest your slides under the cover; they are then air-tight, and will not dry up. B.Sc., Plymouth.

109.—Pictures of Leaves.—A method of obtaining impressions of leaves, which I have practised with success, is described in "The Young Man's Book of Amusements," published in Halifax in 1840. It is as follows:—

Excellent Method of Taking Off Impressions of Leaves, Plants, etc.

"Take fine wove paper, which oil well with sweet oil; let it stand a minute or two to soak through, then remove the superfluous oil with a piece of paper, and hang it in the air to dry; when the oil is pretty well dried in, take a lighted candle, or lamp, and move the paper slowly over it in an horizontal direction, so as to touch the flame, till it is perfectly black. When you wish to take off impressions of plants, lay your plant carefully on the oiled paper, and a piece of clean paper over it, and rub it with your finger equally in all parts for about half-a-minute; then take up your plant, and be careful not to disturb the order of the leaves, and place it on the paper on which you wish to have the impression; cover it with a piece of blotting-paper, and rub it with your finger for a short time, and you will have an impression superior to the finest engraving. The same piece of black paper will serve to take off a great number of impressions, so that when you have once gone through the process of blacking it, you may make several impressions in a very short time. The principal excellence of this method is, that the paper receives the impression of the most minute veins and fibres, so that you may obtain the general character of most flowers superior to any engraving. The impressions may afterwards be coloured according to nature."

I have found the impressions liable to be spoilt by friction of other paper, etc., in a portfolio. It will, therefore, be advisable to fix them with gelatine, or some other fixative, such as is used for crayon drawings. E. S. Courroux.

Queries.

All Questions and Answers should be clearly and concisely written on one side of the paper only, and every question or answer must bear the name and address of the writer. If this is written on the left-hand bottom corner, it will not be published, in which case initials or other signature should appear in the usual place. When more than one question is sent by the same correspondent, each must be written on a separate piece of paper.

Correspondents, in sending us answers to questions, are desired to commence by quoting the number and title of the question as printed, before beginning their replies.

163.—Erector for Microscope.—Will some expert in lens-grinding give a good formula for an erector? W.

164.—Size for Holding Diatoms on Slide.—What is the best size for holding diatoms in arranged slides? H. A. S.

165.—Hardening Injected Tissues.—I should be very glad if any reader will inform me how to successfully harden animal tissues which have been injected. I have tried spirit, as Dr. S. Marsh recommends in his little book, but cannot succeed to my satisfaction. W. H. P.

166.—Cuticle of Leaves.—Will any of your readers kindly inform me the best and simplest way of separating the cuticle from the under side of leaves? Have tried Carpenter's and Davis' method, but cannot succeed. T. G. J.

167.—Double Flowers.—What is the physiological cause of the production of "double" flowers, and how are they to be cultivated? E. S. COURROUX.

168.—Biology.—Will some reader tell me what are the best books on biology for one who has to work without any teacher? J. B.

169.—Coarse Adjustment for Microscopes.—Will any reader of experience tell me what are the advantages and disadvantages of microscopes with rack-and-pinion, and sliding coarse adjustment? J. B.

170.—Platino Cyanide of Magnesium.—Will someone kindly tell me how the very beautiful microscopic slides bearing the above name are prepared? S.

171.—Aquatic Insects.—I shall be much obliged to anyone who will tell me the best method of mounting delicate aquatic insects and animalculæ. C. H.

172.—Distribution of Atmospheric Pressure.—On referring to isobarometric charts (that is, charts on which lines, called isobars, are drawn through all places where the height of the barometer is the same) we find that (1) a broad belt of low pressure extends round the equitorial regions of the globe; (2) on each side of this there is a parallel tract of high pressure; and (3) about each pole there lies a region of low pressure. Can any of your readers explain fully why a region of low pressure does occur round each pole? S. G. M., Carmarthen.

173.—Tobacco Plants.—In my garden border here I had a considerable number of the tobacco plants planted, which are well known to be annuals. However, in renovating the borders, a quantity of the roots had been allowed to remain in the ground, and from these roots which were left in the ground other plants have sprung up, which certainly now class this plant among perennials. Moreover, those plants which have sprung from the roots left are of a *deeper* and much *richer colour*, and remain

perfectly open all day, whereas the other plants only remain open at night. Has this been known to occur before? A.

This query came too late for insertion in our December number, but in "Answers to Correspondents" we suggested that the new plants were probably seedlings; to this our correspondent has replied:—

I beg to say that the *new growths* are not seedlings, but, as I have stated previously, are sprung from the roots of plants remaining in the ground from last year, and as this plant is considered an annual by the authorities, it has at least in our favourable climate become perennial. I shall get some lifted and sent to you if you have any doubts about it. A.

174—Geology.—What is the best book to read for the advanced Stage (Science and Art) in Geology? S. G. M.

175.—Geology.—Would any of your readers be good enough to answer me the following questions, which were set at the last May Examination (Science and Art)? (1).—"How may it be inferred that certain rocks were formed in shallow water?" (2).—"Clays are of various shades of blue, brown, or red, etc.; to what are these differences of colour generally due?" S. G. M.

Reviews.

La Photographie Sans Objectif. Applications aux vuex Panogramiques, a la Topographie a vuex Stereoscopiques. Par R. Colson. pp. 51.

Traite Pratique de Photographie Decorative. Appliquee aux Arts Industriels. Par V. Roux. pp. 48.

L'Eclairage des Portraits Photographiques. Par C. Klary. pp. 67. (Paris: Gauthier-Villars. 1887.)

We have before us three valuable treatises on very different phases of photographic art from the well-known press of M. Gauthier-Villars; in the first the author points out some of the advantages to be gained by using a simple dark chamber without a lens, and accompanies his treatise with a view of the Dome of the Invalides, taken with such a chamber by an exposure of twenty seconds. Mr. Roux's treatise contains directions for the Transference of photographic films to glass, porcelain, etc. M. Klary is evidently a practical photographer, and his descriptions of the best mode of producing the highly valued Rembrandt portraits are worthy of careful study and attention.

Traite Pratique de Gravure et Impression sur Zinc, par les procedés Héliographiques. Par Geymet. Première partie, Préparation du Zinc-Gravure. Seconde partie, Methods d'Impression. Procédés Inédits, pp. 98—150. (Paris: Gauthier-Villars. 1887.)

The extensive use which is at the present time being made of Photo-Zincography gives great interest to M. Geymet's treatise on the Heliographic process, whereby impressions are transferred to zinc, and thence printed after the lithographic manner. The work consists of two parts: first, the preparation of the zinc-plate; and second, the transference of the photographic image to the prepared plate.

Sale and Exchange Column.

Wanted, "Sach's Botany," 2nd edition.—J. Boyd, Dean's Bridge, Armagh, Ireland.

About 40 specimens of Rocks, Minerals, and Fossils, correctly named, with localities where found. Also, a number of Scientific and other books (nothing worse than new). For price, send stamped envelope to S. G. Morris, Science School, Carmarthen.

Wanted, *Science Gossip* for 1871, 2, and 3, complete; bound or unbound.—F. R. Brokenshire, 24 Oxford Terrace, Exeter.

I have for disposal Vols. II. and V. of the *Intellectual Observer*, in good condition. What offers?—F. R. Brokenshire, 24 Oxford Terrace, Exeter.

Diatoms.—Spread Slide of Aulacodiscus Africanus (similar to that circulated by Mr. F. Martin in P.M.S., box No. 151) in exchange for other Diatom Slide.—J. B. Bessell, Fremantle Square, Bristol.

I am contemplating adding to my Micro-paraphernalia an Achromatic Condenser, and should be glad of any information as to the merits of the various kinds offered by different makers. I am using at present a "Webster," and get very good results up to a point; but I want something that will co-operate with a first-class one-tenth immersion, so as to procure from the latter its very utmost capabilities with the more difficult diatoms. If any of your readers using high-angled Condensers will favour me with their experience, it will be esteemed a favour. My stand is a first-class full size.—F. R. Brokenshire, Exeter.

Hand-painted Lantern Slides of Micro Objects, also Micro Preparations, in exchange for named cabinet specimens of Diptera and Hymenoptera not in collection.—Chas. Watkins, Painswick, Gloucestershire.

Small Air-Pump for Preparing Microscopical Objects, not much used, cost £1 when new. What offers in Glass Slips, ground edges, 3 in. by 1 in., or Spoiled Slides, *not scratched?*—M. Farhall, 7 Lorna Road, West Brighton.

I have some beautiful pieces of Batrachospermum. Those caring for any send small bottle and postage.—M. Farhall, 7 Lorna Road, West Brighton.

Will exchange two vols. of Cassell's "Our Own Country" (unbound) for Darwin's "Origin of Species," or any scientific books.—Lester Francis, 16 Wansey Street, Walworth Road, London, S.E.

Wanted, Microscopic "Turn-table."—L. Francis, 16 Wansey St., Walworth Road, London, S.E.

Fossil Diatomaceous Materials from Lough Neagh, Ireland.—Rev. H. W. Lett, M.A., Aghaderg Glebe, Loughbrickland, Ireland.

Worked Flints, Paleolithic and Neolithic, in exchange for Fossils.—Apply to J. French, Felstead, Essex.

Microscopical Slide Labels for Animal and Vegetable Kingdom, toned paper, 6d. per 100; samples of 33 kinds, 2d.—Chas. Watkins.

Insects in Spirit and Dry, selected for Mounting. New List ready.—Chas. Watkins, King's Mill House, Painswick, Gloucestershire.

High-class Injections from Monkey, consisting of lip, tongue, liver, lung, spleen, finger. The six slides for 5s.—Henry Vial, Crediton, Devon.

Well-mounted Slides of Spiculæ of various Sponges and Gorgonia, in exchange for Diatoms or Diatomaceous Earth.—J. B. Bessell, Fremantle Sq., Bristol.

The Scientific Enquirer.

FEBRUARY, 1887.

The Study of a Few Common Plants.*

BY GEORGE L. GOODALE.

IX.—FRUITS AND SEEDS.

[CONCLUDED.]

THE ripened fruit-leaves, with their contents, constitute the fruit. But, in maturing, it is often the case that some other parts grow ripe too, and, clinging to the fruit proper, are to be regarded as a part of it. For instance, a strawberry is mainly a pulpy receptacle upon which are dotted the true fruits which look so much like seeds. This is not the place to classify or enumerate fruits; but a few words respecting some of the more common kinds may not be amiss. When the carpel or carpels ripen into fruit, the latter may open at maturity, or it may remain closed. The opening sorts are *pods* of many kinds, *capsules*, and so on, the closed sorts are the *berry*, in which the whole ovary ripens into a pulpy mass with a thin or thick skin; the *stone-fruit*, with a hard bony, or stony shell, in which is the seed—the shell usually covered with a fleshy or fibrous mass, as in the peach and the almond; the *nut*, which has an extremely tough integument; and *akenes*, or *achenia*, which are one-seeded and dry fruits, usually small. Owing to the singular but not very deep disguises which the pistil takes on during its ripening into fruit, it affords a most excellent object of study. We can watch the stages in an apple-blossom, for instance, and detect the character of the modifications which occur after the petals have fallen and the fruit begins to form. The range of fruits at the command of the student in a city is pretty wide, and yields material which may be utilised for solid study which must be profitable.

* From "Guides for Science Teaching." Boston, U.S.A.: Ginn, Heath, and Co.

Within the fruit are the seeds. An exception, which may be mentioned in passing, is found in the Conifers, including the Pines, Spruces, and so on, which have seeds, but do not possess any closed pistils; and so, according to the definition, *cones* are hardly to be called fruits. The seeds in fruits which remain closed are not furnished with any independent means for dispersal: here the dissemination is effected, if at all, by the fruit in some way. But the seeds of fruits which open at maturity are not infrequently furnished with wings, plumes, and hairs, upon which they can be carried in the air for considerable distances. Many of the one-seeded fruits which do not open when ripe have means for dissemination, such as wings, plumes, and hairs, like the seeds spoken of; and others have grappling-hooks, claws, teeth, and so on; while some of them are so constructed that they can be fastened securely in the ground when they have found a good place. A good case of this has been described by Hanstein.*

"Each of the pods or valves of *Erodium* is pretty long and roundish near the base, where it is fastened by a point. At maturity, the outer side of each contracts by drying more strongly than the inner, and thereby causes an outward curvature and separation of the parts of the fruit. But, the tissue of the awn or prolongation of the pod being hygroscopic, it extends again by absorption of moisture from the air. On further drying, the awn by more complete contraction on one side rolls up to form a perfect screw, whilst only the upper extremity bends out into a sickle-like curvature. If the fruit is fastened perpendicularly on a support, the curved end moves like the hand of a watch, sometimes backwards, sometimes forwards, with every change in the amount of atmospheric moisture, and on this depends the well-known application of these fruits in the construction of simple hygroscopes. The very large fruits of *Erodium gruinum* are especially adapted for this study. When drying, the fruit forms a left-handed screw, so that with increase of moisture the tip turns like the hand of a watch; by diminution of moisture, it goes the other way. If such a fruit is put in a fresh and therefore extended state on soil which is not too moist, the tip of the beak will describe at first a broad, lateral, sickle-like curvature, while in its lower part twisting begins. Supported on the curved upper end, the fruit rises, and by means of its point gains a position which is inclined to the ground. By increasing torsion, it therefore penetrates the soil, and straightway is fastened there, for it is wholly covered with little bristles which, being directed somewhat up, act like grappling-hooks. By further spiral movement, the fruit goes more deeply into the ground, since the end of the awn fixed in a slanting direction against the ground can neither

* Botanische Zeitung, 1869, p. 530.

penetrate it nor yield. While thus one turn follows another, the spiral nearest to the head of the fruit bores into the ground like a cork-screw, and pushes the true fruit before it and more deeply down."

The fruits of our cultivated Pelargonium exhibit nearly the same phenomena.

The good of wide dissemination is easily understood. It enables the embryo plant in the seed to have a better start in life than if it had to grow up under the shade of, and in rivalry with, the plant which produced it. In one very striking case, the seeds are furnished with hairs, which are turned to great account in the arts. Cotton consists of the plant-hairs found thickly packed upon the seeds of *Gossypium*. This plant-hair is the only one which has yet been successfully used in spinning.

Regarding the useful products from the vegetable kingdom other than those already mentioned, very little can now be said. In almost any of the following treatises a large amount of information respecting these will be found :—" Lessons in Elementary Botany," by Prof. Oliver ; (London and New York : Macmillan and Co.)—" A System of Botany," by Le Maout and Decaisne, translated from the French by Mrs. Hooker.—" A Class-Book of Botany," by Prof. Balfour of Edinburgh.—" Thomé's Botany," translated from the German by A. W. Bennett. As examples of useful products from the vegetable kingdom, we may mention Rubber from the milky juice of many plants ; Opium, the concrete milky juice of the unripe capsules of the Poppy ; Cocoa, from the seed of *Theobroma ;* Tea, from the leaves of a species of *Camellia ;* Coffee, the seed of a sub-tropical tree and so on.

X.—Movements, and Parasitism.

It remains now, in closing, to call attention to a few curious vegetable phenomena which always excite interest :—1st. Movements. These may be (1) chiefly mechanical, as in the dried parts, which change form and move, when water is applied. The " Resurrection Plant " of California, and the *Erodium*, are good illustrations of this. (2) The spontaneous movements of twiners like Major Convolvulus and Hop-vine ; (3) movements after touch or shock, as in the case of the Sensitive Plant. 2nd. The insectivorous plants, especially *Drosera*, can be grown with facility at any ordinary window, and many of the phenomena described by Mr. Darwin in his " Insectivorous Plants " can be examined. The tentacles of *Drosera* may be seen to bend over and down upon the prey which they sooner or later consume as food.

Lastly, attention should be called to the fact that many plants have no leaf-green (see Vol. I., p. 143), and therefore have to

depend upon other organisms for nutriment. They are generally white, or whitish.

"There are some parasites which obtain only a portion of their nourishment thus at second-hand: they possess more or less leaf-green, and are able to assimilate inorganic matter; but, at the same time, they attach themselves to the stems, or roots, of other plants, and absorb elaborated juices from them. Such plants are called partial parasites. There are several species belonging to the Figwort family, in which this partial parasitism has been clearly demonstrated. As in the case of the *Gerardias*, the foliage is green, and the appearance of the plants does not suggest that they are obtaining any of their food in a surreptitious manner. A few of the roots become attached to the roots, or underground stems of other plants, and draw from them elaborated nourishment." *

The parasites, just referred to, have flowers, and produce true seeds; but by far the largest number of parasitic plants and of saprophytes belong to the lower groups, which produce no seeds with embryo plants therein. These lower plants are termed Mushrooms, Moulds, and Rusts. It is in these latter groups that the lower confines of the Vegetable Kingdom are reached. Such simple organisms—the yeast-cells, for instance, sofar as the food is concerned—have so much in common with animals, that some naturalists have placed them in a middle kingdom between the vegetable and animal worlds, for they have some characters of both. At any rate, these lower plants, devoid of leaf-green, hide from view any sharp line of demarcation between plants and animals.

The Study of Worms.†

By Alpheus Hyatt.

Chapter II.—Nereis Virens. Plate I.

NEREIS VIRENS ‡ is one of the commonest of marine worms. It is found along our coast, burrowing in the mud between tide-marks. Its colour is a dull green, tinged with red, and, like the earthworm, is beauti-

* Sprague's Wild Flowers, p. 15.

† From "Guides for Science Teaching." Boston, U.S.A.: Ginn, Heath, and Co.

‡ A good figure of this species can be found in Morse's "First Book of Zoölogy," p. 83, Fig. 83.

The common name for the Nereis is the "sea-centipede," but it is misleading, as the structure of the worm is very different from that of the well-known land animal, Centipede, of the class Myriapoda.

fully iridescent. For class instruction, alcoholic specimens may be used.

Upon examination it will be observed that the body of Nereis is much larger and longer than that of the earthworm, and the rings broader, though fewer in number, and that no segments are altered, or, speaking scientifically, differentiated to form a "saddle," though the first two rings are greatly modified to form a distinct head.

Pl. I., Fig. 3, taken from Turnbull's paper, "On the Anatomy and Habits of Nereis Virens," shows the head and a portion of the body. The first ring (Fig. 3, *hd* 1) is provided with four eyes and two pairs of antennæ. One pair is short and slender (*a* 1), and the other pair, which is also attached to the second ring, is short and stout (*a* 2). Each of the second pair of antennæ (or palpi, as they are sometimes called) has a small, rounded lobe at its end. The second segment (*hd* 2) is larger than the first, and is sometimes called the mouth-ring because it contains the mouth. The skin of this ring is wrinkled longitudinally. This segment bears four pairs of delicate, unjointed antennæ (*a* 3—*a* 6), which are arranged in pairs, the outer (*a* 4, *a* 5) being short, and the inner (*a* 3, *a* 6) the longest. The animal carries these in front, or on the sides of its head, to aid it in searching for food, and also to warn it of the approach of danger. As in the earthworm, the mouth opens into a pouch, or proboscis, which can be turned outwards and used for obtaining food. In many alcoholic specimens this remains permanently everted, showing two large, black, hook-like jaws, one on either side. A number of little teeth may also be seen arranged in groups upon its inner surface, which look like so many tiny black dots.

We might infer that Nereis, possessing such a dental apparatus, would be carnivorous in its habits; but, though it is very voracious, devouring other worms and marine animals, it does not despise vegetable diet in the form of marine algæ. Turnbull states that it is such a greedy worm, "it will even devour its own immediate relatives if hungry when it meets them;" and one worm, confined by him in a small dish of water, bit itself entirely through near the middle.

The whole body of Nereis is covered with a thin, tough cuticle like that of the earthworm, which may be removed without difficulty. The last segment bears a pair of appendages, called cirri, and is perforated by the anal opening.

In this worm the sexes are distinct. During the breeding season the eggs fill the body cavity, and pass out through openings on the ventral surface, which are difficult to detect. The eggs are found in masses, between tide-marks, lying on the mud.

The most important characteristic, and the one which, at a glance, distinguishes Nereis from the earthworm, is the row of appendages which extends on either side the whole length of the body. Every ring, excepting the first two, may be seen to have a pair of these appendages, which are called "paddles," because, though they are used for respiration, they are also locomotive organs. In order that their structure may be more clearly seen, the student should cut out one of the largest segments, and examine it with a pocket lens.

Fig. 4 shows the paddles, and also the relative position of the internal parts in one segment of the body.

bw represents the body-wall. On either side a paddle (*p*) may be seen, which is divided into a dorsal and ventral portion (*dp* and *vp*) ; *s*, *s*, are the bunches of bristle-like setæ ; *r* is the intestine, which runs the whole length of the body ; *pc* the space surrounding the internal organs or viscera, and, therefore, known as the perivisceral cavity ; *ns* is a nerve ganglion, which is only one of a chain of ganglia, or nerve centres. These extend along the ventral surface of the body, connected by a nerve band consisting of two chords, which unite to form the ganglia. There is a ganglion to each ring, and it supplies nerves to its own segment ; *sg* are segmental organs, so called because they are found in nearly every segment of the body. Some of these organs act as kidneys, and others as oviducts.

The two principal blood-vessels of the Nereis run the whole length of the body ; one (*vv*) along the ventral surface, and the other (*dv*) along the middle of the back, which may be seen in a living specimen. The ventral vessel gives off in every segment of the body, excepting a few in the region of the head, two smaller vessels, one on either side. Each of these divide into two branches, one of which (*vb*) goes to the lower portion of the paddle, while the other (*ib*) passes upward round the intestine. The branch (*vb*) connects with the branch (*db*) in the upper portion of the paddle, and this connection is probably made by the capillary vessels like *co*. The blood, forced backwards from the head into the ventral vessel, flows into the branches, (*vb*) and (*ib*). The branch (*ib*) receives the blood from the vessel (*db*), and then flows into the dorsal vessel (*dv*), where it may be seen passing in waves towards the head. It is in the numerous blood-vessels of the paddles that the blood is purified by throwing off carbon dioxide and absorbing oxygen from the air in the water. In the living worm the red blood in the minute capillaries may be seen through the delicate, transparent walls of the paddles.

Fig. 5 is merely a diagram representing the segmented body of the worm, and the relative position of the different systems : *c.s.* is the circulatory system, *d.s.* the digestive system, and *n.s.* the nervous

system. What is meant by a segment, or ring, is an imaginary transverse thick slice through the body, which contains in itself, and carries on its exterior, the typical organs and appendages of the worm, each ring in the body being, to some extent, a repetition of its neighbour.

It must be understood that the paddles are true appendages formed by the budding out of the walls of the body. This distinction is essential because it is necessary, in comparing the Crustacea with the Worms (as we hope to do in our next number), to contrast the hard, jointed appendages of the former, with the soft, unjointed paddles of the worm. These appendages cannot be compared with the setæ of the earthworm, as it has already been seen that the latter are not true appendages, but simply bristles adapted for locomotive purposes.

It is well to note, however, that in having segmented or jointed appendages the Lobsters differ from the Worms, as do also the Myriapods, Spiders, and Insects. In fact, these types and the Crustacea can be spoken of together under one name, as the Arthropoda, or animals with segmented appendages, and thus contrasted with the Worms.

Short Papers and Notes.

Natural Gas.

Gas-wells are 5⅝ inches inside diameter, and average 1,600 feet in depth. It costs $3,000 to $6,000 to drill and case a well. The pressure at the mouth of the well varies from 40 to 1,238 lbs. to the square inch, and with this range furnishes sufficient carbon to substitute 50 to 1,000 tons of coal daily. Notwithstanding the great friction on the pipe, gas travels at the rate of 6⅔ miles per minute. It is the only self-mining and self-propelling fluid known. The "life" or duration of wells is not yet fully demonstrated. Wells opened twenty-four years ago are yet flowing with undiminished pressure, and those which are apparently exhausted renew their full pressure after being cleaned out. The combustion of natural gas is so perfect, remarks the *Chicago Mining Review*, that there is practically no flame. It burns with a pure rose colour and makes a tremendous heat. It is exceedingly penetrating, and this, combined with the entire absence of odour, renders it a dangerous agent. It is proposed to odorise it by passing it over a tank containing the refuse from coal-tar and ammonia. It is so subtle that it will pass through paper or gold or silver leaf. It is destructive to animal life when inhaled for a

short time. The most generally accepted theory as to the origin of the gas is that the water from the earth's surface, penetrating to the inner fires, is decomposed into hydrogen, and this, gathering into large bodies, is freed by the drill and rushes to the surface. According to this theory, the supply can never be wholly exhausted so long as the processes of nature continue as at present.

How Thirsty Plants get Water.

In the arid regions of Egypt, M. Volkens, a French botanist, has found roots twenty times as long as the part of the plant above the surface. On some of these desert plants the same observer has noticed a very curious moisture-absorbing contrivance. Glandular hairs put forth by the leaves yield a bitter crystalline liquid, which spreads out at night and collects the dew.

How to See One's Own Brain.

Dr. Fraser Halle some years ago contributed a remarkable discovery to the *English Mechanic and World of Science*. Fifty years have elapsed since Purkinjê observed that by passing a candle to and fro several times by the side of the eye, the air in front was transformed into a kind of screen, on which was reflected what was then supposed to be "a magnified image of part of the retina." Sir C. (then Mr.) Wheatstone believed it to be "the shadow of the vascular net-work." Mayo thought it was "an image of the blood-vessels of the retina." Sir Benjamin Brodie, to whom Dr. Halle wrote on the subject, could not identify it with any part of the retina, and said that it was to him "really incomprehensible." By means of more careful drawings, Dr. Fraser Halle resumed the exploration, and succeeded in identifying the picture with the representation of the "anterior lobe of the cerebrum." The picture consists, he has long observed, of "red convolutions with dark interspaces," among which a whitish admixture is sometimes visible. These, he says, constitute exactly the image of folds of the anterior lobe of the brain with the furrows between them. The candle should be moved to and fro about four inches below the eye, and three and a quarter inches from the face. When the movement ceases the undulations, of course, all cease, and the image disappears. A reddish mist appears first, and the image is soon developed and defined. Night is the best time for it, but it can be seen in a dark place faintly in the daytime.

Mixing Sugar with Mortar.

The attention of Mr. Thomson Hankey, Tunbridge, has (as he writes to the *Times*) been called by a gentleman well known in the scientific world to a new use for sugar, which, at the present low price of that article, might be capable of being practically applied. Experiments (he says) have recently been made proving that sugar is a valuable ingredient in mortar and cement, having strong binding qualities. Equal quantities of finely-powdered lime of a very common kind were mixed with an equal quantity of good brown sugar, with the addition of water, and the result was a cement of exceptional strength. This has been tried at Peterborough Cathedral, two large pieces of stone of the broken tracery of a window having been joined firmly together by sugared mortar. The severest test is joining glass, which gives no hold to mortar without the use of sand, and this has been successfully done. It has been suggested to me that the use of sugar is the secret of the success of the old Roman mortar.

The Production of Wood-Wool.

The French scientific journal, *La Nature*, describes and illustrates a machine for making a product which is coming into favour in various different employments under the name of wood-wool. As its name implies, this material is simply wood cut into such fine shavings, it answers many of the purposes to which wool is commonly applied. Although it was at first intended merely as a packing material, it was soon found that it had a much more extended field of usefulness. It is being employed for stuffing mattresses, as bedding for cattle, for the filtration of liquids, etc. It is elastic like horsehair, and is beautifully clean in use. The wood used by preference is Riga fir; and the machine will produce, without any necessity for skilled labour, more than 1,500 lbs. of "wool" per day of ten hours.

The Clayton Fossil Tree.

The celebrated fossil tree at Clayton, upon which a paper was read by Mr. Adamson at a recent meeting of the British Association, has been purchased by Prof. Williamson, F.R.S., for Owens College, Manchester. It is the most gigantic carboniferous fossil yet discovered.

The North Pole.

Two French gentlemen recently explored the island of Spitzbergen in a manner never done before. They have measured the

mountains, mapped the whole coast, examined the vegetable products, the geological composition, etc., of the island. They found that the long day, extending over several months, during which the sun never sets, became intensely hot after a month or two, by the unceasing heat from the sun. In this period vegetation springs up in great luxuriance and abundance. The North Pole is only a matter of about 600 miles from the island, and it is thought by the two explorers, as by many others, that the Pole itself, and the sea which is supposed to surround it, could be reached without any great difficulties being encountered. A singular fact noticed by the explorers in connection with this island is the enormous quantities of floating timber which literally cover the waters of the bays and creeks. A careful examination of the character, condition, and kind of these floating logs would, no doubt, lead to a conclusion as to whence and how they came, and probably suggest new theories for the solution of geographical problems connected with the Arctic seas.

Preserving Museum Specimens.

A new fluid for preserving museum specimens, so as to keep their colour, size, form, and consistency for several weeks, has been devised by Professor Gravitz. It consists of 150 grms. of sodium chloride and 20 grms. of saltpetre to 1 litre of water. To this is added 3 per cent. of boracic acid.—*Science Annual.*

Staining Fluid.

Carmine, 10 grains; strong liquid ammonia, ½ drachm; Price's glycerine, 2 ounces; distilled water, 2 ounces; alcohol, ½ ounce. The carmine is to be placed in a test-tube, and the ammonia added to it. Upon applying the gentle heat of a spirit-lamp, it is dissolved. Boil it up for a few seconds, and allow it to cool before adding the glycerine and the rest of the ingredients. Lastly, pass it through a filter, or allow it to stand by, and decant off the celar solution. The solution should neither be too alkaline nor perfectly neutral. If the former, the colouring becomes too intense, and thus much of the soft or imperfectly-formed tissue is destroyed; and if the latter, the uniform staining of tissue and germinal matter equally mars the result. The permeating power of the solution may be increased by the addition of a little water and alcohol.

After the specimen has been properly stained, it should be washed in a solution, consisting of—strong glycerine, two parts; water, one part; and then transferred to the following acid fluid:—Strong glycerine, one ounce; strong acetic acid, five drops; where it must remain three or four days to regain the volume it occupied when fresh. It is then mounted in balsam in the usual way.

R. S., Jr.

Preparation of Diatoms.

Seeing the great number of questions which have appeared in this journal, I have sent the following notes, which I believe will give general satisfaction to those who have the patience to try them. Prof. Brun says:—"I have devised the following process for the destruction of the endochrome and the preparation of diatoms. It is so convenient, and gives such good results, that I feel it a duty to devote a few lines to making it known. To a magma* of fresh diatoms, still moist, add some crystals of permanganate of potash dissolved in a small quantity of water (1 part of the salt to 10 of water). If the diatoms are dry, pure, or mixed with earth or organic matter, moisten with a small solution of a concentrated solution of the salt, and in which there are still some crystals in excess. The reaction of the permanganate must be continued for about twelve hours. It is sometimes desirable to remove the mixture to the bottom of the 100-grm. phial, and then place it in a warm oven or in the sun. The phial must afterwards be half-filled with water, and a little calcined magnesia (about 0·50 centage) added. This must be allowed to act for two or three hours, occasionally shaking the contents. Now add 1 grm. every minute for ten minutes of pure hydrochloric acid. When the contents of the phial are bleached, the process is complete. In order to facilitate the reaction, plunge the phial into hot or boiling water. The usual washing and decantation may now be employed; for the washings absolutely-pure, distilled water is *imperatively* necessary. In this process we have, first, the energetic oxidation of the endochrome by the permanganate and magnesia; afterwards the liberation of oxygen gas, which acts as an oxydiser (comburant), and then the disengagement of the chlorine, which acts as a bleacher. Doubtless, it is to these multiplied or successive reactions upon the valves, both externally and internally, that the perfect cleaning of the silica is due. By this treatment the delicate species are not corroded, especially if before the addition of the acid a sufficient quantity of water is added. The surface of the valves having lost all its "coleacterine," appears with all its brilliancy, and the minutest details, the striæ or puncta, are clearly distinguished." I have for several years successively tried all the physical and chemical processes which have been published, and I am able to say that I have found none of them in which the results are so perfect and so uniform. I fear, however, that in *all* cases it may not prove so effective when much vegetable or animal matter is present as the old sulphuric acid and chloride of potash process.

V. A. L.

* A crude residuum.

Preparing Sections containing Typhoid Bacillus.

The piece of spleen, say, to be examined: harden it in alcohol, make sections, place these in the following staining liquid:—Concentrated methyline blue added to distilled water, made alkaline by the addition of a little potash water till the mixture attains an intense blue colour. The solution is filtered each time before use. Leave sections in this solution for a variable period, from a few minutes up to a day. They are then placed in acidulated water and thence into alcohol to remove the colouring matter, and left in the alcohol for such a length of time as to leave only the baccili and nuclei stained. V. A. L.

[Translated from "Die actiologische Bedentung des Typhus Bacillus," Von Dr. Eugen Fraenkel und Dr. M. Simmonds (Hamburg und Leipzig), 1886.]

Answers to Queries.

147.—Flocculent Matter in Diatoms.—I believe the best way is to boil large forms in pure soap; let the diatoms soak and pour off the soap and water. For the small forms the Aqua Ammonia is preferable. A. S.

148.—Tortoise.—The reason the tortoise, mentioned by R. H. J., would not eat lettuce was probably because it had left off eating for the winter. This they generally do as soon as the cold weather sets in, when they make preparations for hybernation. I had one two or three years, and, although he never hybernated, he would not touch a morsel of food throughout the winter, from about the middle of September until the latter end of April, when his appetite returned, and in proportion as the weather got warmer, the more ravenously he ate. Roaming at will in the garden he would eat of just the choicest plants—tiger-lilies, pinks, pansies, etc. The proper food to give them is any succulent or milky vegetable, or plant, as lettuce, cabbage, dandelion, milk-thistle, etc.; the dandelion, in my opinion, being the favourite. W. F.

150.—What Bird?—E. H. R. asks the name of a bird "nearly twice the size of the house sparrow," and from his description I believe it is the nuthatch (Sitta Europœa); but if so, he is mistaken as to the size. The nuthatch is rather shorter than the sparrow. H. L.

150.—What Bird ?—It is rather difficult to say for certain what bird it was, but I should fancy it to be the greater redpole (Fringilla cannabina). I once saw one on the top of an apple-free at the house where I was staying one summer. It chirped with all the monotony of a spinning wheel. As far as I made out it was a very ordinary large-beaked finch, with a stripe on its wing. I asked my host, and he gave me the above name.

A. H. S.

150.—What Bird ?--The insectivorous bird a correspondent asks in our last the name of, is what is known in the neighbourhood as the " Bletherin Tammie," or stone-chat.

ADAMSON, Motherwell.

151.—Talc.—This substance was used by the older microscopists for covering their specimens, but is rarely used now for preparations intended to be permanent ; it is sometimes substituted for a film of seleniter, and sold with cheap polariscopes, but it is not satisfactory. F. K.

151.—Talc.—Reading Saville Kent's work I came upon the following passage. After giving objections to the use of thin glass as a cover for microscopic objects under high powers, that author says :—" This substance, represented by ordinary talc, as extensively used for gaselier shades, may with a little practice be split into laminæ of such extreme tenuity that they may be blown away with the slightest breath, while for perfect evenness and transparency they will compare favourably with the finest manufactured glass. With the employment of these talc-films the investigation of Infusoria with the 1-16, 1-25, or even the 1-50 inch objectives becomes a comparatively easy task. The material in question possesses the further considerable advantages of bending readily, and permitting the object-glass to be brought close down on the more remote objects in the microscopic field, while it may be cut with the scissors to any required size or shape." (Manual of Infusoria i., p. 115.) V. A. L.

152.—Continuous Observation of Micro-Fungi.—Mr. E. J. Bles, of Manchester, uses an ordinary glass slide, $3 \times 2\frac{1}{2}$ in., such as would be used for mounting large sections on, and has cemented to one corner a strip of glass which projects beyond the stage of microscope, and is then bent down at right angles, so as to dip into a small jar of water. A centrally-perforated piece of blotting-paper, with a strip from one corner hanging over into the water, is placed on the slide, and upon that a deep glass cell 1 1-10 in. in diameter, which can be procured with both edges ready ground, a piece of thin caoutchouc is easily tied over one end. Working with medium powers one is able to keep some

specimens of pond life under observation, unfortunately not continuous, for some length of time. A description of Dallinger and Drysdale's Damp Chamber is given in *Microscopical Journal*, 1874. (Marsh and Kent's "Infusoria," Vol. I., p. 116.) V. A. L.

152.—Continuous Observation of Micro-Fungi.—The following is said to be a good method for the above purpose, but in a study like that of micro-fungi there is no short and golden rule for their study:—Put some gelatine to soak in water for a few hours, then pour off the water, and melt the gelatine; mix a little glycerine, or a *very* small amount of chloride of calcium with it; and coat glass slides with the mixture; sow the spores of the fungi on this. If they require any special pabulum it must be mixed, if possible, with the gelatine. Of course, the slides must be kept covered, as a rule, as the spores of fungi which are not wanted may be deposited and propagated.

J. G. P. VEREKER.

154.—Preserving Larvæ of Lepidoptera.—Dry the caterpillar with blotting-paper—they can be killed by the ordinary cyanide bottle—make a slit in end of the abdomen, place it between two fresh pieces of blotting-paper, and gently squeeze the contents through the aperture, commencing with the head. When the contents are all out, get an ordinary straight glass blow-pipe, but with a piece of watch-spring tied on the end, so as to form a spring. Insert the pipe between the skin, let the spring down so as to prevent the larvæ slipping off. A grass stem will do very well, but then the caterpillar requires tying on with fine cotton. Next get a spirit lamp with piece of wire gauze over it to keep the caterpillar from singeing. Even an ordinary iron, heated and placed in a stand, so as to keep it face up, does very well. Hold the caterpillar over the gauze, and keep blowing until it is thoroughly dry, which will vary from some seconds to a few minutes, according to the species. Care must be taken not to blow too hard, or the caterpillar will be distended out of its natural shape. With practice, a continuous blowing can be kept up by breathing through the nose. When dry, some mount them on pieces of straw, or artificial leaves, with a pin stuck through the stem, but I prefer mounting them on dried leaves of the natural food-plant.

G. F. WHELDON.

154.—Preserving Lepidopterous Larvæ.—In *Science Gossip*, Vol. XIX., 1883, Pages 35, 36, there is a long article on the subject by Mr. W. Finch, jun. V. A. L.

154.—Preserving Larvæ of Lepidoptera.—"G. S." will find various methods in detail, with illustrations in "The Insect Hunter's Companion," 3rd edition. London: W. Swan Sonnenschein and Co., Paternoster Square, 1s.; also articles on the

subject in *Science Gossip*, 1870, p. 51; 1879, pp. 58 and 256; 1883, pp. 21 and 35; also see 1884 volume.

CHAS. J WATKINS.

155.—Extracting Minute Snails.—Very minute shells (*Vertigo Pupa*, etc.) cannot be emptied of their animal contents successfully. The best plan is to put the living molluscs in tepid water, and allow them to protrude their foot to the fullest possible extent; then add suddenly boiling water, when, with considerable care and labour, part may be extracted—the muscular nerve, opaque mass, foot, etc. Those shells too small to be cleared of the animal by the ordinary method of scalding and picking out, there is no necessity to attempt the operation, as the creature will dry up sufficiently to leave the shell transparent enough to satisfy the student. Carefully clean your shells of all extraneous matter, by washing well before mounting them in the cabinet, leaving those too minute to clear of the molluscs to thoroughly dry (in a pill-box). Caustic potash is *not* to be recommended, as it destroys the epidermis of the shell, as in many instances the character of the species depends on keeping this intact—*e.g.*, *Helix aculeata*, *Planorbis albus*, etc.

Handsworth. G. SHERIFF TYE.

157.—Crystals for Polariscope.—I would recommend the use of castor oil to mount crystals in, and I think your correspondent will be no longer troubled by the unpleasant results described by him. V. A. L.

164.—Size for holding Diatoms on Slide.—Dissolve pure, clean gum, either arabic or tragacanth—the latter is preferable—in distilled water, and filter carefully, To a two-ounce phial of distilled water put five or six drops of the gum. A drop of this very dilute gum-water will be sufficient for each thin cover, on which it should be spread out to the edges and allowed to dry. After the diatoms are arranged, they are to be fixed by just gently breathing on the cover once. The cover, with the arranged and fixed diatoms, must then be thoroughly dried before applying Canada balsam or styrax. H. W. LETT, M.A.

164.—Size for fixing Diatoms to Slide.—I use the following:—Febiger's size, made:—acetic acid, 12 drams; photographer's gelatine, 2 drams; alcohol, 1 dram. Use a porcelain dish. Add the acid to the gelatine, and stir in a water-bath until dissolved; then add the alcohol, and filter. Spread on the slide with a fine needle.

V. A. L.

167.—Double Flowers.—Double flowers are, I think, with Mr. John Gibbs, the consequence of a course of self-fertilisation under conditions favourable to the vital energy of vegetative growth. A double variety of *Primula sinensis* has been raised at Southampton

by florists, who say that to obtain double varieties the raiser fertilises certain fine and striking single flowers with the pollen of other equally fine single blooms on the same plant, and the desired result is obtained. Dr. Master mentions a plant of *Camellia Japonica* at Vienna, from which seeds were saved, the flowers having been fertilised with their own pollen. All the plants raised from these seeds bore double flowers. V. A. L.

168.—Biology.—It is a little difficult to work biology without a master, the student meeting so many obstacles in his path that he gets discouraged. He must not rely on books *too much*, but on actual *dissections* and *comparisons*, noting particularly the changes and differences between each animal. Huxley and Martin's "Biology" (6s., Macmillan) must be possessed, and in addition I find the two following little works a good introduction :—"General Biology," MacGinley, 1s. 6d. (Collins) and "General Biology," Dr. Aveling, 2s. (Freethought Publishing Co., London). Wilson's "Zoology," 1s. (Chambers), is strongly recommended, as all the articles are those studied in biology (excluding plant-life). The atlases of McAlpine on Biology (7s), Zoology (10s. and 7s. 6d.), Parts I. and II., etc., and Howe's Biology (14s.), are very useful.
V. A. L.

168.—Biology.—When the frog is to be dissected, I would recommend the student to work with Marshall's "Frog," 3s. 6d. (2nd edition), Owen's College Biology series (Cornish), leaving out the chapters on the nervous system the first or second time, as they are very difficult to beginners. When fairly known, I would suggest using Martin and Huxley, which is slightly more extensive. Care, patience, and perseverance are required to follow this delightful study, and when acquired will doubly repay the student for the labour and time given to it. V. A. L.

169.—Coarse Adjustment for Microscopes.—English microscopists favour the rack and pinion; continentals the sliding coarse adjustment. I think for a beginner the rack and pinion is probably the easiest to work with. B.Sc., Plymouth.

170.—Platino Cyanide of Magnesium, and Micro-Crystallisation.—The following rough notes may be of use to "S." The magnesium salts do not contain a large number recognised as micro-crystals; but the well-known Epsom salts, or magnesium sulphate, will produce, according to the mode of crystallisation, very varying results. The most typical, and one readily produced, is obtained from a saturated, or nearly saturated, aqueous solution, which, if allowed to crystallise very slowly on a slide, will result in much larger crystals than if the slide, with a small drop of the solution, is very gently warmed. These crystals, if mounted in pure balsam, will, with selenite, form a brilliant

slide. The platino cyanide is the most beautiful and easy to prepare. Most of them, it will be found upon experiment, offer almost insuperable obstacles to any but a scientific chemist. To obtain the specimens, make a strong, but *not* quite saturated solution in pure alcohol, and place a drop on cold slide, which should be covered with a shade of some kind to prevent the *too* rapid evaporation of the alcohol. A watch-glass will answer this purpose, which allows time for the gradual building-up of the desired crystal; but if, as frequently happens, it is found that good crystals have not been produced, drop upon the *same spot* a little more of the solution. This will re-dissolve the crystals already formed. Again cover with a shade, and in due time new and probably better crystals will be formed. When the crystallisation is satisfactory and thoroughly dry, the slide may be mounted in Canada balsam and benzole. Some crystals possess a character which by some is termed dichroism, but which is, I think, most properly designated fluorescence, and is well shown in the platino cyanides, more particularly those of magnesium or yttrium. Another peculiarity of some crystals was in 1837 designated by Fox Talbot as analytic—that is, they have a power of analysing polarised light like a tourmaline, and when examined on the microscope stage do not need the analyser above the objective. This power is possessed by the platino cyanides, boracic acid, murexide, hippuric acid, nitrate of potash, iodo-sulphate of quinine, and many others. Fine slides *have* been produced by the combination of two or more salts—copper and magnesium, copper and ammonium, copper and potassium, chromium and potass, chromium and ammonium, and many others, and of which process of combination platino cyanides are fine illustrations.

V. A. Latham, F.M.S.

171.—Aquatic Insects (Protozoa and Small Larvæ).—I would recommend "C. H." to try the methods given in Vol. I. *Scientific Enquirer*, pp. 172 and 194. Prof. Fol uses an alcoholic solution of ferro-perchloride to kill small animals without injury to the tissues. It is diluted with water down to 2 per cent., and then poured into the vessel holding the animals. These then sink to the bottom. Pour the water off, and add 70 per cent. alcohol. Change the alcohol, and add a second dose of it to a few drops of sulphuric acid; otherwise the iron may remain in the tissues and cause them to overstain with colouring re-agents. The alcoholic washing must be *thorough*. Larger animals (medusæ, etc.) may be perfectly preserved by this method. The tissues may be subsequently stained by adding a few drops of gallic acid (1 per cent. solution) to the alcohol containing the specimens. The nuclei are stained dark, the protoplasm light-brown, in twenty-four hours.

V. A. L.

Queries.

All Questions and Answers should be clearly and concisely written on one side of the paper only, and every question or answer must bear the name and address of the writer. If this is written on the left-hand bottom corner, it will not be published, in which case initials or other signature should appear in the usual place. When more than one question is sent by the same correspondent, each must be written on a separate piece of paper.

Correspondents, in sending us answers to questions, are desired to commence by quoting the number and title of the question as printed, before beginning their replies.

176.—Cleaning Foraminifera from Sand.—The following method is given in many books, being probably copied from one into another without being put to the proof:—Dry the material and throw it into water, when the shells will float and the sand will sink. As a matter of fact, however, a certain amount of the sand also is kept afloat by "surface tension" or "capillary force," and if this sand be sunk by stirring, many of the foraminifera will also sink, so that after several failures one is led to abandon the method, and take to hand-picking as an alternative. Have any of your readers been successful with the process of "floating," and if so how have they managed it? G. H. Bryan.

177.—Sugar-Ant.—Can anyone tell me how to destroy the sugar-ant, *Formica saccharivora?* It is at present injuring my cane-fields in Jamaica to a terrible extent, and bids fair to be as formidable a pest as it was seventy years ago, when it was imported thither from Granada. Train-oil and flowers of sulphur are effectual for fruit-trees in England, but something cheaper and stronger would be required for sugar-canes. E. E. J.

178.—How to Prepare Head of Gnat.—I shall be glad if anyone will inform me how to prepare and mount the head of mosquito or gnat, showing labium, mandibles, maxillæ, and tongue. I find, to begin with, great difficulty in separating the different parts without damaging them. E. B.

179.—Mounting Insect Organs.—I should be obliged if anyone would inform me the best method of preparing and mounting sting and tongues of bees, etc. I have tried first soaking in diluted acetic acid, also diluted nitric acid, and also turpentine, but find that none of these produce that clearness and transparency which is so characteristic of those bought from opticians.
W. B.

180.—Best Illumination for Stephanoceros.—What is the best method of illumination of viewing, *e.g.*, Stephanoceros, with high powers to bring out detail; a horn to retain in a position (extended), for drawing with camera lucida? J. T.

181.—Eye in Cyclops.—Can any reader inform me whether, in regard to the fresh-water animalcule, *Cyclops*, the red spot in the centre of the head is in reality an eye or merely a highly sensitive organ? In examining one the other day under a half-in. objective, the red spot was of somewhat an angular form, and I did not observe any feature about it that would lead me to suppose it to be an organ of sight. AMATEUR.

182.—Change of Lobster's Colour.—The cause of a lobster turning bright red when boiled is a mystery I never yet heard explained. Can any of our readers inform me? V. A. L.

183.—Photographic Plate Varnish.—Is it necessary to varnish the stereotype negative photographic plates to preserve them; and if so, which is the best varnish to use? M. G. S.

184.—Plant-Crystals.—Can anyone tell me if *Deane's Gelatine Medium* is a trustworthy preservative medium for mounting leaves and other portions of plants containing crystals? I am aware it is an excellent mountant for showing the crystals, but do they keep in it? Mr. W. H. Hammond some years ago recommended *Deane's Gelatine Medium* for this purpose, but it is supposed to contain honey, and honey has a powerful acid action in some substances—for instance, zinc—and I would be afraid of how it might act on the oxalates and phosphates of lime in the crystals. Glycerine in every form, though recommended by so great a name as Prof. Gulliver's, is to be avoided, as in time it dissolves lime. A friend of mine once lost a whole series of valuable spicules owing to their being put up in some mixture (by a professional mounter), in which glycerine was a component.

H. W. LETT, M.A.

Notices of Microscopic Slides and Appliances.

Mr. H. P. Aylward, 164 Oxford Street, Manchester, has sent us a specimen of a newly-invented, opaque, wood slide for micro objects, which appears to possess some special advantages. It consists of a parallel-sided, sunk cell, beyond which is a parallel-sided groove to hold a brass-flanged ring. The object is put into the cell, a thin cover-glass laid on the top of it, and the brass ring dropped into position holds all perfectly secure, and if pressed tightly down, we believe, air-tight also. The special qualifications Mr. Aylward claims for this slide are its simplicity, and also that owing to the dryness of the wood botanical objects need not be thoroughly dried before mounting. The wood will absorb any dampness that may be left, and in so gradual a manner that all shrinking or curling of the specimen will be avoided.

We beg to direct the attention of our readers to a new advertisement on the cover of the *Enquirer* from Mr. Anderson. Mr. A. has sent us the six slides there referred to, and these, upon careful examination, we are bound to

say are well mounted. They represent in each case entire insects, and show well all the organs of special interest. These slides are all mounted *flat*. We would suggest to Mr. Anderson the desirability of mounting another series of the same *unpressed*, at an additional charge. We think they would find a ready sale. At the same time, the slides under notice are excellent.

Sale and Exchange Column.

Wanted—Re-Agents. Accessories, etc., for Histological work.—Apply, stating requirements, to F. R. Rowley, 60 Lower Hastings Street, Southfields, Leicester.

Microscopical.—Slips, Thin Covers, Media, Cements, etc., 33 kinds of Labels; samples, 2d. *Unmounted Objects* as fine Polariscopic Horn and Hoop Sections, Insects, Zoophytes, brilliant selected Show Objects from Exotic Lepidoptera, etc.—Chas. Watkins, King's Mill House, Painswick, Gloucestershire.

For selected slide of *Coscinodiscus radiatus*, send other selected slide, material for selecting, or offers.—G. H. Bryan, Thornlea, Trumpington Road, Cambridge.

Wanted, "Sach's Botany," 2nd edition.—J. Boyd, Dean's Bridge, Armagh, Ireland.

About 40 specimens of Rocks, Minerals, and Fossils, correctly named, with localities where found. Also, a number of Scientific and other Books (nothing worse than new). For price, send stamped envelope to S. G. Morris, Science School, Carmarthen.

Wanted, *Science Gossip* for 1871, 2, and 3, complete; bound or unbound.—F. R. Brokenshire, 24 Oxford Terrace, Exeter.

I have for disposal Vols. II. and V. of the *Intellectual Observer*, in good condition. What offers?—F. R. Brokenshire, 24 Oxford Terrace, Exeter.

Diatoms.—Spread Slide of Aulacodiscus Africanus (similar to that circulated by Mr. F. Martin in P.M.S., box No. 151) in exchange for other Diatom Slide.—J. B. Bessell, Fremantle Square, Bristol.

Hand-painted Lantern Slides of Micro Objects, also Micro Preparations, in exchange for named cabinet specimens of Diptera and Hymenoptera not in collection.—Chas. Watkins, Painswick, Gloucestershire.

I have some beautiful pieces of Batrachospermum. Those caring for any send small bottle and postage.—M. Farhall, 7 Lorna Road, West Brighton.

Will exchange two vols. of Cassell's "Our Own Country" (unbound) for Darwin's "Origin of Species," or any scientific books.—Lester Francis, 16 Wansey Street, Walworth Road, London, S.E.

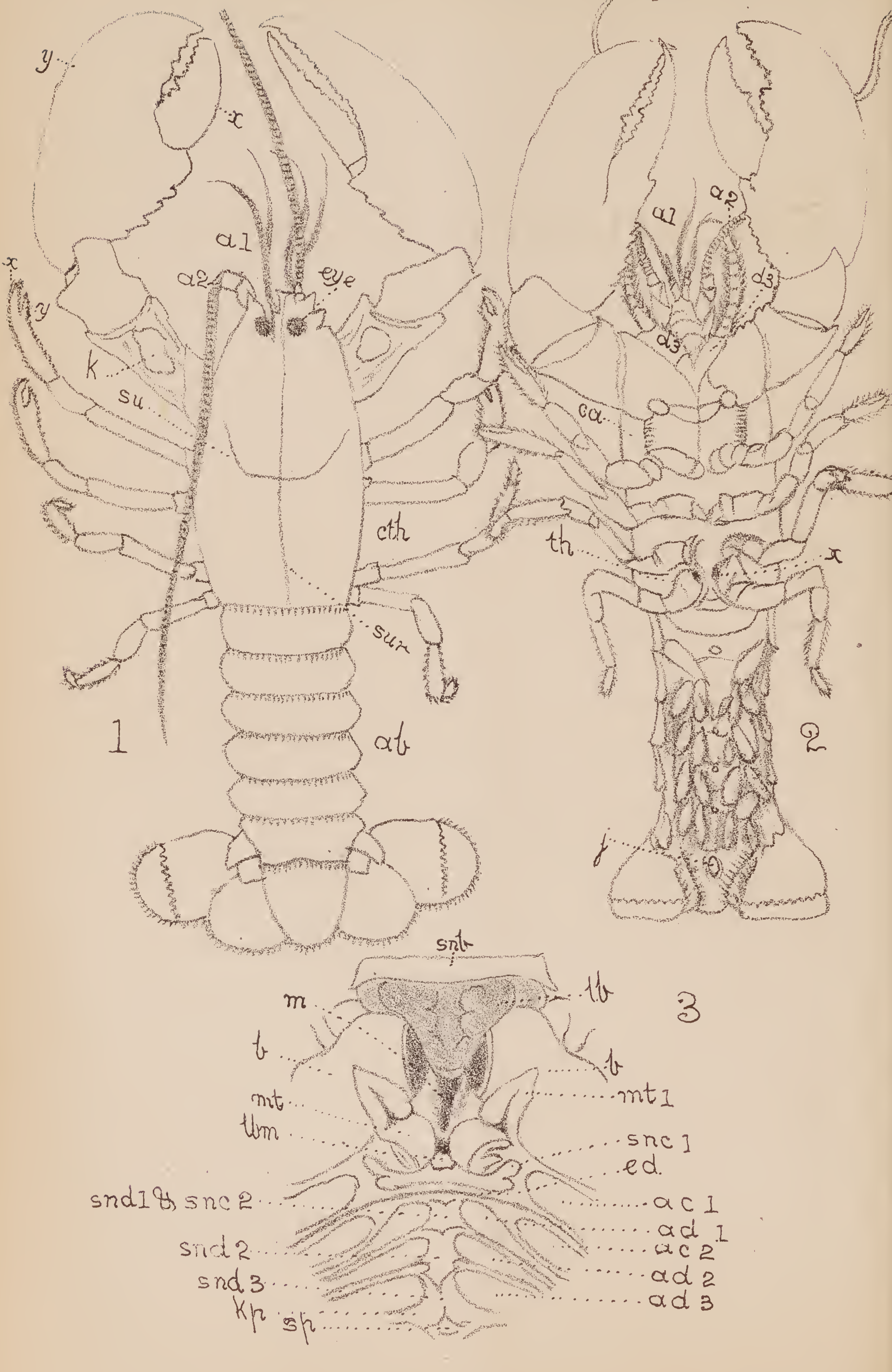
Wanted, Microscopic "Turn-table."—L. Francis, 16 Wansey St., Walworth Road, London, S.E.

Fossil Diatomaceous Materials from Lough Neagh, Ireland.—Rev. H. W. Lett, M.A., Aghaderg Glebe, Loughbrickland, Ireland.

Worked Flints, Paleolithic and Neolithic, in exchange for Fossils.—Apply to J. French, Felstead, Essex.

High-class Injections from Monkey, consisting of lip, tongue, liver, lung, spleen, finger. The six slides for 5s.—Henry Vial, Crediton, Devon.

Well-mounted Slides of Spiculæ of various Sponges and Gorgonia, in exchange for Diatoms or Diatomaceous Earth.—J. B. Bessell, Fremantle Sq., Bristol.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Crustacea.

The Scientific Enquirer.

MARCH, 1887.

Crustacea.

By Alpheus Hyatt.

Chapter I. Plate II.

EITHER the lobster, or the fresh-water crayfish, is common, and of sufficiently generalised structure to be taken as the type of the class, and the student should make himself familiar with one of these. Boiled specimens of the lobster may be obtained in all the markets or at the fishmongers.

Fresh-water crayfishes are abundant in many of our rivers.* On account of their small size they are more convenient to use, and with the exception of a few important modifications, the structure of the two animals is the same, so that a description of the lobster will answer for that of a crayfish.†

Every lobster should be placed for examination upon its lower or ventral side, with the head turned from the student. The body will then be above, and the organs known as the lobster's appendages will project from the lower surface on either side (Pl. II., Fig. 1). This position is very favourable for making instructive comparisons between the structure and symmetry of the human form and that of the creature immediately before us.

The agreements in external symmetry, that it has eyes, feelers, or sense organs, and a mouth forming an anterior end remotely comparable with our own head; that it can be divided by an imaginary plane passing through the centre into halves, equal bilaterally like the human form; that the appendages as limbs for support in walking or swimming are in such bilateral animals, as in our own case, necessarily distributed on the sides; that such bodies

* A drawing of the Crayfish will be given in Plate VI.

† Huxley's book on the "Crayfish" contains a full and accurate anatomy of this interesting form.

which seek their food must necessarily have the mouth and organs of sense at one end, and the organs for locomotion either along the sides or at the posterior end, are all perfectly legitimate and natural comparisons arising from the common characteristics of all animals which move freely, seeking food, self-preservation, and reproduction. The different means and structures which have been produced to meet the common requirements of life upon the surface or in the waters of the earth, are also strongly illustrated by such comparisons, when made with discretion, especially between these free-moving types and such sedentary forms as the Sponges, the Hydra, and the Corals, which have radiate symmetry like plants, mouths or openings above, and no heads.

The body should be studied first, and afterwards the appendages. The body is seen to be long and cylindrical in form, and to be covered with a hard, limy crust or shell. The body is divided into two clearly defined parts. The posterior division, the abdomen (Fig. 1, *ab*), has six distinct, ring-like segments, and a terminal piece, all of which are connected by soft skin, so that they move freely upon each other. The anterior division (Fig. 1, *cth*) does not consist apparently of segments, and is called the carapace, when referring to the visible shell alone, and cephalothorax, when the shell and the thorax inside are both spoken of, because the head and chest appear to be in one piece. The carapace (Pl. III., *A*, *ca*)* terminates in a beak or rostrum anteriorly (*ro*), on either side of which it is hollowed out to give room for the eyes. One important feature of the carapace ought not to be passed over. It will be noticed that an incomplete suture or groove runs from a point near the middle of the back of the shield downward and forward towards the anterior end (Pl. II., Fig. 1, *su*). This suture, which may perhaps be supposed to be merely an accidental mark, is in reality of importance, as will be seen farther on, when the true character of the carapace is discovered.

In order to arrive at this result, it will be essential to study the appendages and the typical segment. Turn the lobster upon its back, so that the ventral surface, with all the limbs, may be exposed to view (Fig. 2).

It is best to begin the study of the appendages with those of the abdomen, called the swimmerets. Each one of these in the female is seen to consist of a more or less flattened basal portion (Pl. III., *E*, *h* 1), having two sections and two flattened lobes (*E*, *h* 2, *h* 3). The outer lobe is smaller than the inner, and both lobes are fringed with short hairs. Those of the first and sixth rings, in both male and female, however, appear to differ greatly from the others. Closer observation of the first pair (Pl. III., *C*, *f* 1), however, will show the basal section (*h* 1) and the inner

* The Plate will be given in our next number.

terminal lobe (*h* 3), while the outer lobe is undeveloped. In the sixth pair, on the other hand, there is an excessive development of the three parts. The basal section (*h* 1) is broader, thicker, and stouter, and the two delicate divisions have become strong, fan-shaped paddles (*h* 2, *h* 3). The outer lobe is jointed transversely, while both lobes, like those of the other swimmerets, are fringed with hairs.

Having observed the six pairs of appendages, with their six corresponding abdominal rings, the terminal piece, or telson (Pl. III., *C. ab* 7), so called because it means *end*, still remains to be more carefully observed. It is flat and triangular in shape, fringed along its edges, and with the anal opening on its under side. No appendages are found attached to it, and if the lobster were the only crustacean studied, it would be impossible to tell whether the telson was a segment, or a flattened outgrowth in the form of a spine. There is, however, another crustacean, the little crab-lobster, *Porcellana*, living in the warmer waters of the Pacific and Indian oceans, and also as far north on the American coast as Newport, R.I., which can be used to clear up this doubtful question.

This curious little crab possesses a telson, with an unmistakable pair of appendages attached to it, proving that this part is really a ring whose appendages are wanting in the lobster.

If the student has spent sufficient time upon this portion of the lobster's body, he cannot fail to see that it is made up of rings, and that to every ring there is normally a pair of appendages. Also, that all the appendages are built upon the same fundamental type, though differing in the details of form.

The reason for this difference becomes evident when the habits of the living lobster are observed. The appendages of the sixth ring are supported by the telson, and, together with it, form a tail-fin, which is the chief organ of locomotion. This organ, aided by the flexible abdomen, strikes down against the water like a paddle, and with such force that the reaction sends the animal swiftly backwards. By doing work which requires so much effort, the last pair of appendages, as might be expected, are large and powerful. The fifth, fourth, third, and second pairs (Pl. III., *C*, *f* 2–*f* 5) are also pendant paddles, though less efficient, and are, therefore, similar in aspect but not so large. They enable small lobsters to swim in a forward direction, and assist the older ones in sustaining themselves when floated up from the bottom, where the adults habitually crawl. They are constantly in motion, accomplishing little, however, as locomotive organs in the full-grown animal, but in the female they are used for carrying the eggs during the period of oviferation.

The sexual difference between male and female is shown by the condition of the first pair of swimmerets in the female (Pl. III.,

C, f 1), which, being useless, are rudimentary, and by the corresponding pair which are intromittent or clasping organs in the male (see Pl. II., Fig. 2) and therefore appropriately developed. The second and third pairs of appendages in the male also have an additional small lobe on the inner side of the large inner lobe (Pl. II., Fig. 2).

Short Papers and Notes.

A "Blood Prodigy."

THERE is a remarkable fresh-water alga, known as *Hildenbrantia rivularis*, which appears to be unknown to Algologists as a native of the British Isles, since it is not mentioned in the latest authority on that subject—Cooke's "Fresh-water Algæ"—but which Mr. Wm. Archer informs me he believes to have seen in small patches in Co. Wicklow, and which occurs in great abundance on pebbles that are always completely covered with water in the river Poulter, near Retford, in Nottinghamshire.

This stream, which is a tributary of the Idle, has its rise in the high moorland of Derbyshire, and for several miles passes through a limestone district; but before reaching the parish of Elkesley—where the alga referred to is found—it runs through a sandy, gravelly country, and it is on the quartz pebbles derived from the new red sandstone which the current has carried down that it grows.

The *Hildenbrantia rivularis* has much the habit of a lichen. It consists merely of a thin crust, closely attached to the surface of and following any inequalities in the stone. The patches are at first round, but soon become confluent; the surface, when mature, is covered with minute warts containing the fructification, and the margin is somewhat thickened. It looks exactly as if great clots of blood had dropped and spread on the gravel, and this makes the river, for about two hundred yards where it occurs, have, when the sun is shining, an extraordinary appearance, just as if it were running with blood. This, though I have not seen it, I can easily imagine, after inspecting the specimens with which I have been favoured.

At the place where this phenomenon occurs the whole bed of the stream is formed of these pebbles, and they are more or less coated with the *Hildenbrantia rivularis*, which is met with at depths of from four to twenty-nine inches, and always under

water. This Alga evidently likes shade, the banks of the Poulter at the spot being well clothed with trees, and under their protection it flourishes. It is to be remarked that the flow of the stream is fairly rapid.

This curious plant is unique in the tribe of vegetables to which it belongs. It stands alone among the algæ, in a family of its own, which Rabenhorst (Flora Europæa Algarum aquæ dulcis et submarinæ, Vol. III., p. 408) names *Hildenbrantiaceæ*, of which the very common marine *H. rubra* is a species. This latter is described in all the books on Seaweeds—Harvey, Grattan, Johnstone and Croall, etc., but is quite distinct, in many features, from *H. rivularis*. When *H. rivularis* is examined under the microscope with the $\frac{1}{4}$-inch object-glass, or higher power, its tissue is seen to be composed of many strata, or layers, of very minute rounded or angularly-rounded cells, neatly and regularly arranged in rods or vertical series. The little warts which give the surface its granulated nature are conceptacles, open at the top, and containing numerous oval sporangia, which Rabenhorst describes and figures as "pyriform tetraspores."

Retford—*i.e.*, the "red ford"—is situated six miles from Elkesley, but its name has nothing to do with the *Hildenbrantia rivularis*. It was given, it is said, on account of the hue assumed by the river Idle whenever there has been rain in the district watered by the river Meden, which flows through reddish clay—more of the *débris* of the red sandstone—and the current at Retford in time of wet becomes the colour of carrot-soup. This appearance soon passes away, the colouring matter settling to the bottom.

Strange as is the sight afforded by the phenomenon, it does not appear to have given rise to any legend or tradition, such as in less enlightened times would doubtless have been born of the idea that it was a "prodigy of blood" and one of the "signs of the times."

There would seem to be some humour among the natives of Notts, as evidenced by the facetiousness they indulge in when naming their rivers. Some little distance below Elkesley the river Mann (man) joins company with the river Meden (maiden), and thus united the water flows through Retford, under the designation of "Idle."

Specimens of the pebbles incrusted by this alga, and the foregoing particulars about the locality have been kindly furnished to me by the Rev. Canon A. F. Ebsworth, M.A., Vicar of East Retford, and the Rev. Justice Chapman, M.A., Vicar of Elkesley.

The discovery of this new British Alga is another instance of the truth of Gilbert White's (letter XX.) statement, that "that district produces the greatest variety which is most examined;"

and affords encouragement to observers by proving that everything has not yet been worked out by us botanists.

H. W. Lett, M.A.

Ancient Chart of the Heavens.

Among the many curious and interesting books found in the National Library of Paris is a Chinese chart of the heavens, made about 600 B.C. In this chart 1460 stars are correctly inserted, as corroborated by observations of modern astronomers.

On Watering Potted Plants.

In the operation of watering potted plants, persons not practically familiar with plant-culture are apt to make serious mistakes. Cultivators find by experience that an excess of water at the roots is very injurious to almost all plants, and hence it is usual to direct that great caution be used in the application of water, especially in winter. The result is that frequently the opposite extreme is fallen into, to the great injury of the plants. From the moment that the soil becomes so far dried that the fibres of the roots cannot absorb moisture from it, the supply of the plant's food is cut off and it begins to suffer. Some plants can bear this loss of water with more impunity than others; some, again, and the heath family among the rest, are in this way soon destroyed. The object in watering should be to prevent this stage of dryness being reached—at least, during the time a plant is growing—and at all times in the case of those of very rigid structure. At the same time, that excess which would sodden the soil and gorge the plants is also to be avoided. Within these limits, the most inexperienced persons may follow sound directions for the application of water with safety. But whenever water is given to plants, enough should be employed to wet the soil thoroughly, and the difference between plants that require more or less water should be made by watering more or less frequently, and not by giving greater or less quantities at a time.—*Farmer's (Irish) Gazette.*

The Use of Snakes.

Persons who dislike snakes, says the *New Orleans Picayune*, continually ask, "What is the use of them?" That they are not without their use will, I hope, appear in the course of this short paper, were it necessary to preach that all things have their use. But in one habit that offended Lord Bacon—namely, of "going on their belly"—lies one of their greatest uses, because that, together with their internal formation and external covering, enables them to penetrate where no larger carnivorous animal could

venture, into the dark and noisome morasses, bog-jungles, swamps, amid the vegetation of the tropics, where swarms of the lesser reptiles, on which so many of them feed, would otherwise outbalance the harmony of nature, die, and produce pestilence.

Wondrously and exquisitely constructed for their habits, they are able to exist where the higher animals are not, and while they help to clear those inaccessible places of the lesser vermin, they themselves supply food for a number of smaller mammalia, which, with many carnivorous birds, devour vast numbers of young snakes. The hedgehog, weasel, ichneumon, rat, peccary, badger, hog, goat, and an immense number of birds keep snakes within due limits, while the latter perform their part among the grain-devouring and herbivorous lesser creatures. Thus beautifully is the balance of nature maintained.

A New Glass.

The Prussian Government has aided two gentlemen—Professor Abbey and Dr. Scott—in experiments which have resulted in the discovery of a new kind of glass. The ordinary glass contains six substances; the new glass made by Professor Abbey and Dr. Scott contains fourteen. The most essential elements of which it is composed are phosphorus and boron, neither of which is used in common glass. With the old glass the full power of the microscope was the discernment of the one-five-hundred-thousandth part of an inch, and with the new glass it is claimed that the one-two-hundred-and-four-million-seven-hundred-thousandth part of an inch can be distinguished. When the discovery was first made, Carl Zeiss, the manufacturer, in whose place the experimentalists had worked, was in favour of taking out a patent, so that the discovery might prove a most profitable one, but the fact of the experiments having been conducted with funds supplied by the Prussian Government prevented the discoverers from making it a private enterprise, and compels them to make it a public benefit. The difference between the new and the old glass consists in the refraction of light. The glass is not in the market yet, but will be very shortly. It will be used entirely for high-power instruments. —*Boston Journal of Commerce.*

Bee-Sting Poison.

Those who have been stung by bees may be curious to know what bee-poison is. We are informed by Mr. Frank R. Cheshire, F.L.S., F.R.M.S., in his work on "Bees and Bee-Keeping," that its active principle seems to be formic acid, probably associated "with some other toxic agent." Formic acid takes its name from

the *Formica rufa*, or red ant, which used to be distilled to produce it. It is highly corrosive. A little drop on the hand will produce a sore, so, as may easily be imagined, it is a very formidable agent when injected beneath the skin. Its corrosive effect is greatly increased with its temperature, and when heated to the boiling point it will reduce even salts of silver, mercury, and gold. The idea that a bee invariably dies after stinging is to a certain extent a vulgar error, for the same authority informs us that "it will, if allowed time, generally carry its sting away by travelling round upon the wound, giving the instrument a screw movement until it is free." But it is, however, very rarely that the bee is allowed time to travel round, and consequently "she loses not only the sting and the venom-gland and sac, but also the lower portion of the bowel, so that her death follows in an hour or two." The queen bee has a sting—a very sharp one—and so hard that it will turn the edge of the finest razor, "but never does she in human hands inflict a puncture." Its use, therefore, if this be true, would seem to be obscure.—*Monthly Mag. of Pharmacy.*

Waterproof Paper.

Common paper, by a very simple process, may be converted into a substance as strong as parchment by means of sulphuric acid. The paper is simply dipped in the acid, but the acid must be of an exactly determined strength and mixed with half its bulk of water. A sheet of paper dipped in this liquid is almost instantaneously changed in character. It becomes tough, hard, and fibrous, but its weight is not increased, and it is far better for writing than animal parchment. It stands rubbing better than paper and almost as well as sheep's skin. It serves for vellum in bookbinding and for all legal purposes as well as animal parchment. It may also be used as a substitute for bladders to cover pickle and jam jars. Any paper that has even been printed on may be converted by means of sulphuric acid into vegetable parchment.—*Cassell's Saturday Journal.*

On Mounting Selected Diatomaceæ.

The following method of fixing and mounting picked diatoms will, I think, be found better than those which were recommended in the last number of this journal, and although by no means novel I have rarely seen it mentioned in print. Instead of using gum or gelatine to fix the valves, dissolve a piece of white (bleached) shellac the size of a pea in two drachms of spirit and filter into a small bottle. The cover to receive the diatoms is first placed on the turn-table and a small circle drawn in its centre with water-colour paint. A little experience in searching for the

diatoms on a selected slide not provided with such a "finding circle" will show the necessity of this; moreover, the colour will not dissolve in the balsam. Let the cover be gently warmed, and *then* put a small drop of the shellac solution in its centre; this will spread out into a thin, uniform film over the desired area without interfering with the coloured ring, and when the spirit has evaporated the cover should at once be removed. A number of covers may be thus prepared and kept till wanted. For picking out the valves I formerly used a badger hair sliced off to a slanting point; but now I generally use the finest thread of spun glass, which may be drawn out by heating the glass in a gas-flame. The use of this was first recommended by Professor H. L. Smith. The thread may be attached with gum to the side of a pointed wooden handle, leaving a quarter of an inch projecting; but as the glass is easily broken by rough handling, several such should be fitted up, and it is convenient to have them of different degrees of thickness. Another useful piece of apparatus is a glass slide, with two strips of glass attached to it, in the form of a V, between which the cover can be held while the diatoms are being placed on it. By means of the glass thread, the valves are picked out one by one under an inch objective, and are lightly deposited on the prepared cover. The latter may then be placed under the microscope, and the diatoms arranged in a neat little group in the centre of the finding circle, taking care that specimens having the "hoop" still attached to the valves be placed *face downwards* and deposited *perfectly flat* on the cover. The former precaution is advisable lest air-bubbles be enclosed, in removing which the diatom is detached. To fix the diatoms heat the cover *thoroughly* for at least a minute on the "mounting table," and remove it to cool. Nothing now remains but the mounting. The best way of doing this is first to heat the slide and then apply a drop of balsam, which thus becomes very liquid. If the cover be held over the hot balsam for an instant, the evaporating turpentine will condense on it, and will penetrate the valves before the wave of balsam is allowed to reach them. Care must, of course, be taken not to move the cover about on the balsam, for fear of loosening the valves. In some cases, it is better to put a drop of turpentine on the cover before mounting, to expel the air, as should any bubbles be enclosed between the frustules and the cover, they will be very apt to detach the former; there is also danger of detaching the valves if the balsam be not rendered sufficiently liquid by heat or otherwise.

With proper precautions, however, slides may be produced by this method, which leave nothing to be desired. The shellac is, like gum, insoluble in turpentine or balsam, but it is not noticeable owing to their refractive indices being nearly equal. A similar

way of applying the balsam answers very well for "spread" slides. Should any dust get on the slides, it can easily be removed, unless it get stuck down with the shellac, and then the whole may be scraped off with a knife. I always examine covers with "spread" diatoms before mounting in case any dust should have got on them, and find a "balsamy" needle capital for removing dust. The slides may be cleaned with cotton wool soaked in methylated spirit, followed with water, but should not be ornamented with coloured rings in case it be required to use the Bramhall illuminator with them. Of course, the diatoms might be arranged in patterns, but this sort of work is somewhat fatiguing to the eyes, especially if continued long at a time. But without doing this, I have mounted a good many slides containing from 1 to 30 valves, and have found the above process, as I trust your readers may find it, in every way satisfactory.

Peterhouse, Cambridge. G. H. Bryan, B.A.

The Salt-Rock of Louisiana.

The salt deposit of Petit Anse, in S.W. Louisiana, is one of the most remarkable known. It is of pure crystal salt, covering 150 acres to an unknown depth, having been penetrated 140 feet. It is from one to six feet below the sea-level, and the earth over it is from 10 to 183 feet thick. On the salt beneath the earth have been found remains of prehistoric animals and Indian relics. Above the salt and the animal remains, and of more recent deposition, are strata of coal and sandstone.

Incandescent Gas.

We learn from the *Daily Telegraph* that a trial was made recently at the Marlborough Gallery, Pall Mall, of a new method of gas combustion. In order to obtain the maximum of light from any illuminant, it is first necessary to evolve its whole heating power. This Dr. Auer von Welsbach accomplishes by first passing the gas through a modified Bunsen burner. Over the intensely hot but non-radiant blue flame thus produced, a mantle, which is the special feature of the invention, is placed, and this is raised to a white glow resembling that of the electric incandescent lamp. The mantle is said to be made of cotton steeped in a solution of oxides of zirconium and lanthanum, and some other incombustible elements, and professedly it will "last from 800 to 2,000 hours, and can be renewed at a small cost." Experience alone can test the accuracy of these statements, but of the purity and brilliancy of the light there can be no question. Of these qualities the facility afforded of recognising the most delicate

shades of colour in the pictures exhibited was a crucial test. It was shown experimentally that, as compared with a standard Argand burner, the efficiency of the incandescent light was more than double for the same quantity of gas, and that this was effected with less heat and the absence of any trace of smoke. As compared with the Argand, the new Welsbach burner has the further advantage that it can be applied to all ordinary fittings.

Sound Telegraphs.

The system of sound telegraphy used by the people living on the border of the Gulf of Guinea, West Africa, is of interest as a primitive solution of the problem of communication through short distances. The instrument is made as follows:—Take a log of hard wood, about 2 ft. long and about a foot in diameter. Plane off one side longitudinally, to a surface of four or five inches wide. In the centre of this surface mark off an elongated and somewhat distorted Greek cross. The longer arms are placed longitudinally, and occupy about one-third of the plane surface. The transverse arms are three times as broad, and extend entirely across this surface. The natives dig out the wood within the outline of the cross, and from there gradually hollow out the whole log. The sides beginning at the centre are trimmed off laterally towards the ends, which are rounded off. The instrument is now ready. It will be perceived that by the methods above described we have a hollow drum with four tongues in the centre, each of a different thickness, so as to produce a different sound when struck. Two pieces of bamboo, the size of a man's wrist and about 2 ft. long, are selected and stripped of the hard outside, which leaves the soft, pithy portion for use. This bamboo is of a peculiar kind, free from knots, and solid throughout. With these sticks, used in a proper manner on the four tongues of the drum, a combination of sounds is produced, which, in connection with time as used in music, forms a perfect telegraphic language, readily understood by the initiated, the air being the transmitter. With this simple instrument the natives of the Gulf of Guinea readily communicate with each other for a distance of a mile at least on land, and a much longer distance by water. Messages can be sent long distances in a short time by parties at different points passing them along from one to the other. The writer has seen canoes coming down a river from the bush markets signalling people in the town and giving and receiving general news at a distance of fully three miles.

A Powerful Telescope.

When the great telescope which is to be mounted at the Lick

Observatory, in California, is ready, as it is expected to be in a year or two, it will then be possible to observe the face of the moon with the space between reduced to as short a distance as one hundred miles.

A Heavy Meteor.

The meteor which fell near Claysville, Washington county, Pa., Sept. 14, 1885, was found recently by Professor J. Emerick, of William and Mary College. The stone was found imbedded at the base of a hill. It weighed about 200 tons, but was cracked into pieces by contact with a stratum of limestone. Its composition was chromium, nickel, aluminium, copper, magnesium, tin, and other metals and metalloids. It contained 87 per cent. of iron in a metallic state. Its specific gravity was 7·412. Its elevation above the earth's surface was established at 52 miles, its path nearly horizontal, its flight between five and ten seconds, its visible path 150 miles, and its velocity 15 to 20 miles per second.

The Spider.

When a spider is preparing to moult, it stops eating for several days, and fastens itself by a short line of web to one of the main lines of its snare, which holds it firmly, while it proceeds to undress. The skin cracks all around the thorax, and is held only by the front edges. Next the abdomen is uncovered. Now comes the trouble to free the legs. It works and kicks vigorously, and seems to have very hard work. But continued perseverance of about fifteen minutes brings it out of the old dress, and it seems almost lifeless, and is limp and helpless for several minutes, but gradually comes back to life, and looks brighter and handsomer than before.

To Bleach Bones.

A simple and effective method of bleaching bones, so as to give them the appearance of ivory, has been introduced. After digesting the bones with ether or benzine to recover the fat, they are thoroughly dried and immersed in a solution of phosphoric acid in water, containing one per cent. of phosphoric anhydride. In a few hours after these operations they are removed from the solution, then washed and dried, with the result as stated.

Photographic Seal.

The following is copied from an old volume of the *English Mechanic*, and may be useful to some of the readers of the

Enquirer:—"A German photographer has invented a method of making seals and stamps with portraits of his customers. A thin layer of gelatine, sensitised with bichromate of potash, is exposed to the action of light under a photograph positive, by which the parts acted on are rendered insoluble in water. The gelatine film is immersed in water, and the parts not acted on by the light swell up, and we obtain a picture in relief of which a plaster cast can be taken. A galvanic plastic copy being taken of the cast, we have a metallic fac-simile of the photograph, which can be employed as a seal." B.

A New Remedy for Chilblains.

Wash the affected parts with lukewarm soap and water, moisten with a liniment made up of equal parts of oil of turpentine and sulphoichthyolate of ammonia, and wrap them up in wadding, when the annoying tingling and itching will cease almost instantly.—*The Chemical Review.*

Silvering in the Cold.

Make up a solution of—

Bisulphite of Soda	...	...	1,000 parts.
Distilled Water	...	...	1,000 ,,

Add to it a solution of—

Nitrate of Silver	...	...	60 ,,
Water ...	...	...	200 ,,

The mixture, after being well stirred up, is ready for use. The articles to be silvered—first carefully cleaned—are immersed for a short time in the solution. After they have become coated with silver, they are taken out, rinsed well in water to which a little soda has been added, then again in pure water, and then dried in sawdust. Applicable to iron, steel, brass, bronze, and copper. Do not make too much solution at once, and keep it in a dark place.—R. Kayser, Bayer, *Gewerbe Museum.*

Answers to Queries.

54.—**Pygidium of Flea.**—To prepare this as a test object for microscopic objectives, it is dissected out, and placed in a 25% solution of hydrate of potash for two or three days; it is then to be washed *thoroughly* in water, dehydrated in strong alcohol, cleared

in clove oil, and then transferred to sulphuric ether for three hours; after this it is passed through benzine, then through clove oil, and mounted in balsam. I am indebted to Mr. A. J. Doherty for the method.

V. A. LATHAM.

57.—Food of Tadpoles.—"In the horse-pond were many Tadpoles, hustling and squeezing each other in their anxiety to get a dead kitten; and why should they not fight for good places? The dead kitten is to them what a turtle dinner is to the city folks; each duly appreciated by the rightful customers. But supposing there happen to be no dead kitten or decayed vegetable matter in their pond, what will the poor things get to eat? Why, they will do what the New Zealanders have done before them; viz., ate up every specimen of the Dinornis they could find on the island, and then they set to work and ate up each other; so do the tadpoles. As a proof, I brought home a quart of tadpoles; these I emptied into a tub in the beer cellar; there they lived, being fed on meat several days, till one day on sending for a glass of ale, up comes John with half a smile on his face, and simpers out, 'If you please, sir, I have brought the beer, but I have upset the tadpoles.' On arriving at the scene of the disaster, there were the poor things high and dry on the floor. I restored them to their tub, but forgot to put back their meat. The next morning I found some had not recovered their accident, and round the bodies of their departed brethren were crowded the cannibal survivors, eating and pulling away each for himself. I have sometimes seen capital skeletons of small animals in ponds, the flesh having been eaten away by tadpoles. The habit of eating each other among the tadpoles may by some be considered horrible and unnatural, but when we consider the *thousands* that are hatched from the egg, its beneficial use in the economy of nature will at once be perceived."—Buckland's *Curiosities of Natural History*, 1874, p. 3.

I have not been able to obtain the above before, but hope it may be of use to J. W. G. It is taken word by word.

V. A. LATHAM.

101.—Series of Objectives.—These depend very much on the kind of work to be done, also on the length of tube, a short foreign tube requiring a slightly different series to the long English tube. The real thing to go by is the amplification and resolving power required.

For general work I believe the following to be the most useful amplifications, a few diameters more or less being unimportant, viz.:—20—30; 50—60; 200—300; 400—600.

Now, assume the image made by the objective will stand a magnification of 8 diameters; then by using two eye-pieces we can manage with the following series:—

English tube, 3″ or 2″; 1″; ¼″; ⅛″
Foreign tube, 2″ or 1″; ½″; 1/6″; 1/9″

To this for bacilli and diatom work a 1/10 or 1/12 immersion, preferably "oil," ought to be added.

The resolving power depends mainly on aperture, and to go into full details would occupy too much space. The following are, however, generally considered useful angles:—1 inch 20°—25°; ½″ 40°—60°; ¼″ 90°; 1/6″ 105°, if 1/8″ or 1/9″ is wanted; above 110° it had better be an immersion lens.

There are some new objectives by Zeiss of extra dense glass just coming out, which are said to bear very deep eye-piecing. Of these a 2/3″ and 1/6″ would range from 30—1125 diameters, but they will be very expensive, and are not yet in the market.

J. G. P. Vereker.

163.—Erector for Microscope.—If "W." will hold an equilateral prism over the eye-piece of his microscope, and look down through it at the image in the field, hold the prism with one flat side towards his face, so that there may be two refractions and one reflection of the beam of light, he will see the image inverted or erected, and with very little loss of definition. A holder for a short prism might be easily arranged to slip over the eye-piece after removing the cap, or it might be arranged to go in a society screw-adapter in the draw-tube. A. L. W.

165.—Hardening Injected Tissues.—I would advise W. H. P. to imbed the tissues in celloidin or paraffin, or else to use a freezing microtome. A. W. L.

165.—Hardening Injected Tissues.—After the animal has been injected, I generally place it at once in equal parts of alcohol and water, and allow it to remain in it for some hours, so that the gelatine may become solid. If a carmine mass has been used, alcohol and water is the only fluid suitable for hardening, and a few drops of acetic acid should be added to prevent the carmine becoming diffused when in contact with the tissues. If Prussian blue has been injected, either alcohol, Muller's fluid, or picric acid may be used. Some recommend a $\frac{1}{4}$ per cent. of osmic acid ($O_s\ O_4$). V. A. L.

165.—Hardening Injected Tissues.—Pure alcohol is the best, but as, in the course of hardening and afterwards through keeping, the alcohol becomes impure, the following method is adopted in the German laboratories to ensure that the tissues always lie in the pure portion of alcohol, which is the upper stratum. Half fill the hardening jar with common boys' marbles or "chinas." On this put a layer of wire gauze, cut circular, to fit the jar;

fill nearly to the top wlth pure alcohol. Put in the tissue (generally cut in cubes of about 1 inch), lay aside till hard, and see that the jar is moved about as little as possible. B.Sc., Plymouth.

166.—Cuticle of Leaves.—I would refer "T. G. J." to Vol. I. *Scientific Enquirer*, p. 135, where he will find the question answered. V. A L..

167.—Double Flowers.—What is the physiological cause of the production of "double" flowers, and how are they to be cultivated?

"Although one would scarcely infer from their appearance that the stamens and ovary were *leaves*, they are nevertheless to be classed as such. Evidence for this statement is drawn from the fact, that in certain flowers we find stamens half transformed into petals. This transformation or metamorphosis can be produced in many flowers by special culture; in fact, the phenomenon may be observed in most of those garden flowers which we call *double*. If this *doubling* is perfect, all the stamens will have become transformed into petals. Usually, however, it does not go so far, and we thus find stamens in every stage of transition."—"Text-book of General Botany," by Dr. W. J. Behrens. A. C. F. M.

173.—Tobacco Plants.—On reference to the "Cottage Gardener's Dictionary," it will be found that the following species of Tobacco Plants are mentioned as *perennials*, viz.:—

Nicotiana fructicosa	Pink.
N. Glauca	Yellow.
N. undulata	White.
N. Vincæflora	White.

The same publication remarks that "Shrubby and Perennial" kinds require the warm greenhouse in winter, and may be propagated by *divisions* and cuttings ...... By far the largest number of species, however, are annual. A. C. F. M.

175.—Geology.—(i.) I presume that a microscopical examination and identification of the organic remains found in a detrital rock would enable a correct inference to be drawn as to the depth of the water in which the detritus was deposited, it being known that certain organisms inhabit shallow and others deep waters. (ii.) The various shades of clay are probably due to the different proportions of oxide of iron which it contains, this being formed by the action of the weather on the iron contained in the clay.—See "Text-book of Geology" by Archibald Geikie, F.R.S., etc. etc. A. C. F. M.

176.—Cleaning Foraminifera from Sand.—If G. M. Bryan refers to the *Journal of Microscopy*, Vol. I., pp. 25 and 139, he will find a full description of the process of cleaning Foraminifera from

Sand, by Charles Elcock, one of the most successful of foraminiferists, and whose notes and beautiful slides of these shells we used to be so pleased to see in the boxes of the P.M.S. Mr. Elcock mentions that "the operation called 'floating' was first made known by Professor Williamson, in his Monograph on British Foraminifera (Ray Society)." For my own part, I can say I have frequently carried out the directions in Mr. Elcock's papers, carefully attending, however, to every point, no matter how minute, and have been in my own little way most successful. Mr. Bryan will find the very difficulty he has met described, and Mr. Elcock's plan of overcoming it. H. W. LETT, M.A.

182.—Change of Lobster's Colour.—With reference to V. A. L.'s question, I may say that a similar change will be observed in specimens of crayfish and lobster shells which have been kept in spirit. This fact, would seem to point to the chemical change, as being one in which dehydration plays a prominent part. A. W. L.

182.—Change of Lobster's Colour.—I am not acquainted with the actual reason of this, but, as a small contribution having reference to the subject, have observed the change to be brought about not merely by boiling, but also by strong alcohol, thereby indicating a possibly dehydrating effect. If this be so, the change would be analagous to that which occurs when green cupric hydrate is boiled with solution of soda, thereby losing water and becoming black; or when chloride of cobalt loses water by boiling, thereby becoming blue. J. W. G.

Queries.

All Questions and Answers should be clearly and concisely written on one side of the paper only, and every question or answer must bear the name and address of the writer. If this is written on the left-hand bottom corner, it will not be published, in which case initials or other signature should appear in the usual place. When more than one question is sent by the same correspondent, each must be written on a separate piece of paper.

Correspondents, in sending us answers to questions, are desired to commence by quoting the number and title of the question as printed, before beginning their replies.

185.—India Rubber.—How may articles of India Rubber—say, for example, a tobacco pouch—which has got torn, be repaired? T. J.

186.—Cutting a Hole in Plate Glass.—I have a large circular plate of glass, from which I wish to make an electrical machine,

and wish to cut a hole about 1 inch in diameter to fix the axis for it to revolve upon. How am I to effect this? Of course, I am very desirous not to crack the plate. ELECTRO.

187.—Angular Aperture.—How is the angular aperture of microscopic lenses ascertained? I shall be glad to know the rule for finding it. MICRO.

188.—Bee's Comb.—Will some of your readers kindly inform me whether it is a scientific fact that nature makes nothing in hexagonal form, and the hexagons we find in the insects' compound eye, and the cells of the bee's comb were originally circles, but have become hexagonal by pressure. B. B. B.

188.—Growth of Flies.—Can any of your readers tell me if flies ever grow after arriving at the imago state, and, if not, how their difference in size is accounted for? B. B. B.

189.—To find Amæba.—These most interesting little beings are very difficult to find; at least, I find them so. Many pleasant hours I have spent on them; but if I want some to show to anyone, I may hunt through quantities of mud and water and not see one. Can any microscopist tell me of a sure way of finding them? Do they live in any particular depth in the water, or in certain different muds? M. A. HENTY.

190.—Aurora Borealis.—What causes the Aurora Borealis? There are many reasons given as to the cause. It is usually attributed to electricity, which in its passage from the North Pole to the Equator becomes visible in this form. A beautiful imitation of the rays of the Aurora Borealis can be produced by an electrical machine, which rather furthers this idea. Nevertheless, an electric needle has never been seen to have been influenced by it in any measure in those parts of the world where this beautiful phenomena is most frequently witnessed. Are there any fresh ideas on this subject? and is it being particularly studied by scientific people? M. A. HENTY.

191.—Tinning Rusty Iron.—How could a very rusty piece of iron be tinned without the trouble of scouring off the rust or of filing it off? R. O. N.

192.—Repairing Large Plates of Carbon.—Having broken some large plates of Electrical Carbon, I should be glad to know of any way of joining them so that the joint would stand the effects of Nitric Acid, and yet be a good conductor of electricity. R. O. N.

193.—Problem.—Will some friend kindly show the full working of the following problem:—A vessel holding 1 cubic foot, to be filled with Carbonic Acid at a temperature of 50° F. What will be the internal pressure in this vessel if it be exposed to a temperature of 500° F., atmospheric pressure being the same in each case? P. B. L.

194.—Oxygen from Air.—Wanted an account of any experiments for separating the Oxygen and Nitrogen of the air from each other by means of Dialysis or Osmose. A. I. R.

195.—Pronunciation of Names.—Wanted, the usual pronunciation of the following words. Kindly spell each as it is to be pronounced, indicating the long vowels and accents if possible:—schist, schizocarp, scapigerous, scabrid, systylus, cremocarp, stomata, pileorhiza, homogeneous, perigynous, octogynous (meaning having eight styles), hypogynous, sepal, tunicata, spicules.
B. A. B.

196.—Tadpoles.—Does any one know if tadpoles have been kept by any means in the tadpole state the whole year round, or longer, and if so, under what conditions were they so kept alive?
B. A. B.

Reviews.

First Year of Scientific Knowledge. By Paul Bert. Translated by Josephina Clayton (Madame Paul Bert), late of Banff, Scotland. Post 8vo, pp. 344. (London: Relfe Bros. 1886. Price 2s. 6d.)

This will be found a most excellent book for young people. It treats in a very simple manner of—1.—The Animal Kingdom, divided into Vertebrates, Annulates, Mollusca, and Radiates; 2.—Plants: their General Structure, Classification, etc.; 3.—Stones and Soils; 4.—Physics, Heat, Light, Sound, Electricity, Magnets, Weight, and Gravitation; 5.—Chemistry; 6.—Animal Physiology: Motion, Nutrition, and Sensation; 7.—Vegetable Physiology; and finally there is a short dictionary of scientific terms. We feel sure that all our young friends who read this book will do so with profit.

Typographic Printing Machines and Machine Printing: A Practical Guide to the Selection of Bookwork, Two-Colour, Jobbing, and Rotary Machines, with Remarks on their Construction, Capabilities, and Peculiarities. Also, Instructions in Making Ready, the Preparation of Engravings, etc. By Fredk. J. F. Wilson. Fourth edition, with numerous illustrations. Crown 8vo, pp. xvi.—214. (London: Wyman and Sons.)

Stereotyping and Electrotyping: A Guide for the Production of Plates by the Papier-Mache and Plastic Processes. With Instructions for Depositing Copper by the Battery or by the Dynamo Machine; also, Hints on Steel and Brass Facings, etc. By Fredk. J. F. Wilson. Third edition, crown 8vo, pp. xv.—195. (London: Wyman and Sons.)

These books are of a technical character, and contain a large amount of very valuable information. They are capitally illustrated.

THE CAMERA: A Monthly Magazine for those who Practice PHOTOGRAPHY. Crown 4to, pp. 26. (London: Wyman and Sons. Price 6d. monthly.)

We find here just the information sought for by the practical photographer. A series of good papers is in course of publication on the Optical Lantern. The illustrations are very good, and the plate accompanying the number before us (December, 1886) is exceptionally so.

JOURNAL DE L'INDUSTRIE PHOTOGRAPHIQUE, Organe de la Chambre Syndicale de la Photographie. 8vo, pp. 16. (Paris: Gauthier-Villars. Jan., 1887.)

Owing to a misadventure in the post, this journal came to hand only on the day of going to press. We are unable, therefore, to do more than acknowledge its receipt. We notice that it is in its eighth year of publication, and appears to contain much valuable information.

Sale and Exchange Column.

Mistletoe Berries.—Will give packet of 30 different interesting micro objects, ready for mounting, for 100 ripe berries.—Rev. H. W. Lett, Aghaderg Glebe, Loughbrickland, co. Down.

Grevillea.—Wanted, back vols., either bound or not.—Rev. H. W. Lett, Aghaderg Glebe, Loughbrickland, co. Down.

Coscinodiscus radiatus for diatom, insect, polarising or other non-botanical objects.—G. H. Bryan, Thornlea, Trumpington Road, Cambridge.

Wanted—Re-Agents. Accessories, etc., for Histological work.—Apply, stating requirements, to F. R. Rowley, 60 Lower Hastings Street, Southfields, Leicester.

Microscopical Slips, Thin Covers, Media, Cements, etc., 33 kinds of Labels; samples, 2d. *Unmounted Objects* as fine Polariscopic Horn and Hoof Sections, Insects, Zoophytes, brilliant selected Show Objects from Exotic Lepidoptera, etc.—Chas. Watkins, King's Mill House, Painswick, Gloucestershire.

Wanted, "Sach's Botany," 2nd edition.—J. Boyd, Dean's Bridge, Armagh, Ireland.

About 40 specimens of Rocks, Minerals, and Fossils, correctly named, with localities where found. Also, a number of Scientific and other Books (nothing worse than new). For price, send stamped envelope to S. G. Morris, Science School, Carmarthen.

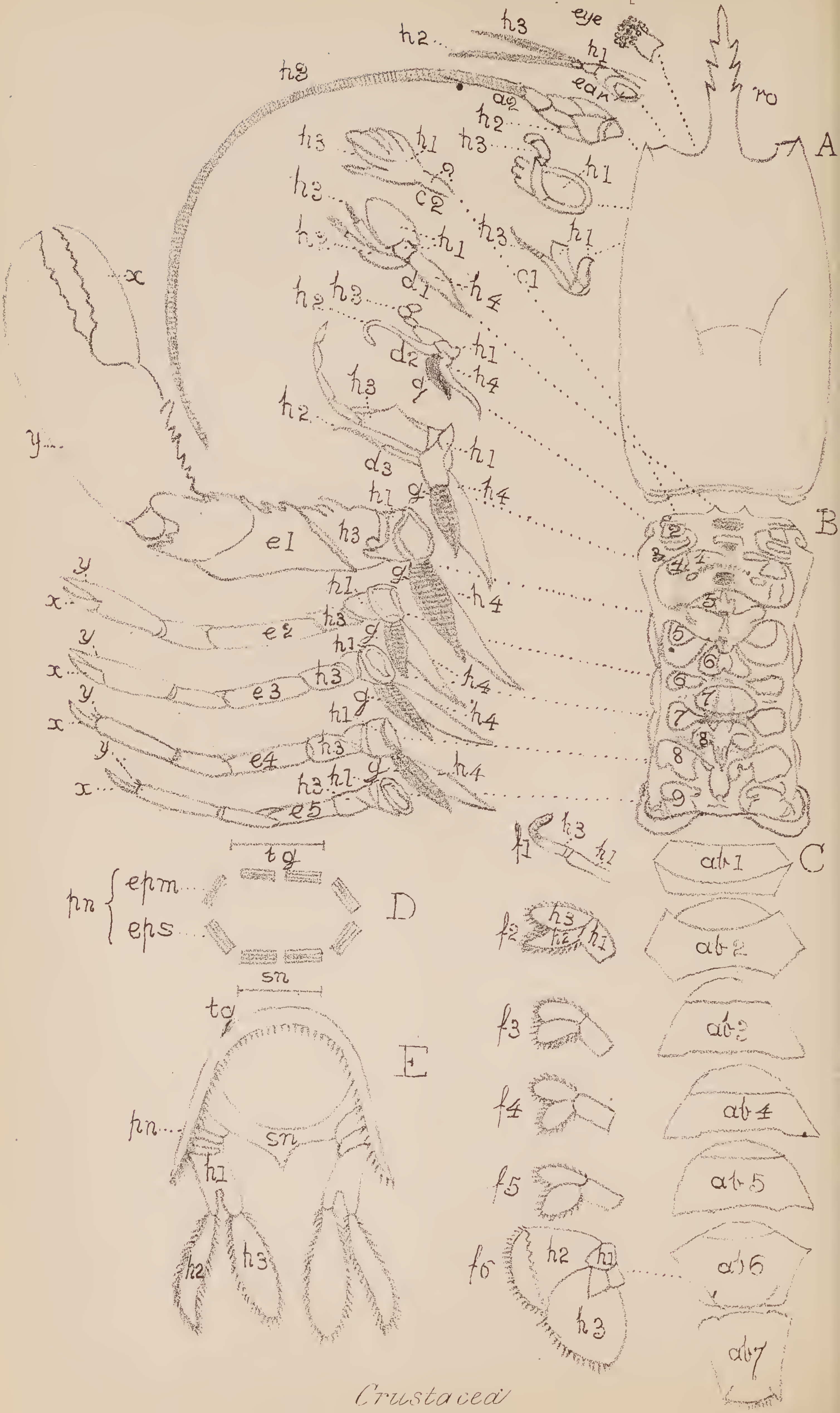
Natural History and Musical Works, Oolitic Fossil Coral, Micro Preparations, in exchange for named cabinet specimens of Diptera and Hymenoptera not in collection.—Chas. Watkins, Painswick, Gloucestershire.

I have some beautiful pieces of Batrachospermum. Those caring for any send small bottle and postage.—M. Farhall, 7 Lorna Road, West Brighton.

Worked Flints, Paleolithic and Neolithic, in exchange for Fossils.—Apply to J. French, Felstead, Essex.

High-class Injections from Monkey, consisting of lip, tongue, liver, lung, spleen, finger. The six slides for 5s.—Henry Vial, Crediton, Devon.

Books for Sale.—Anatomy of Blow-Fly, B. T. Lowe, 8s.; Introduction to Entomology, Kirby and Spence, 1867, 3s.; Introduction to Entomology, Westwood, coloured plates, 1838, 4s.—J. B. Bessell, Fremantle Square, Bristol.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Crustacea

The Scientific Enquirer.

APRIL, 1887.

Crustacea.*

BY ALPHEUS HYATT.

CHAPTER II. PLATE III.

BEARING in mind the general plan of structure discoverable in the lobster's abdomen, we will now pass on to the cephalothorax. The five pairs of appendages in front of the swimmerets are usually called the walking-legs (Pl. III., *B*, *e* 1—*e* 5). This number has given the name of DECAPODA, or ten-footed Crustacea, to the order. The last four pairs of walking-legs—counting always from the anterior end backwards—have seven sections and the first pair six sections; the fifth and fourth pairs terminate in short spikes (*x*). Those of the fifth pair are well suited for being used to push and shove the body ahead. The pliability of the terminal joints secure the points of the sections from slipping, and allow the legs to act against them at any angle in pushing the body forward without renewing the hold, until the whole length of the leg and the full force of one step has been economised. The terminal sections or spikes of the fourth pair are larger, more sharply pointed, and thrown out forwards and sidewise. They are hooked into the surface of the ground, and used to drag the body and lift it at the same time. The white, worn points of the spikes in both of these legs, and the positions which they can be made to take by manipulation, show how they are used.

At the base of each of the spikes, on the last pair of legs, is a little spine (*y*), which is really a downward prolongation of the sixth section. It can be felt very sensibly, though at first it may not be seen, concealed as it is by the short hairs upon its apex and the longer hairs on either side. Passing to the third and second pairs of walking-legs, the student will be able to infer from his own observation that the counterpart of this little spine in

* From "Guides for Science Teaching." Boston, U.S.A.: Ginn, Heath, and Co.

each pair is the jaw-like prolongation of the sixth section (*y*), equal in length to the last section. This growth has taken place on the inner side, and the result is the formation of a clasping organ, of which one section is movable, while the other is immovable. Here, then, whenever the animal requires it, the movable part will begin to clamp objects against the immovable portion; or, in other words, rudimentary jaws will be formed, which need only teeth to become capturing or crushing organs like those at the ends of the first pair. These walking-legs are carried well forward under the first pair, and are useful in lifting up, supporting, and moving these heavy parts.

The movable section of the jaws alone is used when the animal is walking upon a hard surface, and then it has the same function as the corresponding seventh section in the fourth limb. The worn, white tip shows again just where wear takes place. The nipping power of these jaws is slight, but they are used to lay hold of objects when the animal is in danger of being dragged out of its hole under the rocks, or from between masses of seaweed, and are also particularly useful when some fish, or other large prey, struggling to get free, drags it along over open ground. The jaws are then widely opened, and forced deep into the sand, and, together with the other legs, afford a very firm resistance.

The first pair of walking-legs (Pl. III., *B*, *e* 1) have become modified into large arms. The fifth section (*y*), which corresponds to the sixth of the other walking-legs, is here greatly developed; and it is, apparently, the outer and not the inner portion of this section which is prolonged to form the fixed jaw.

Here, as elsewhere in nature, things are not always what they seem. The big arms in the young are legs precisely similar to the others, but subsequently, during growth, they are stretched out forward, and used horizontally for grasping, and not used for walking. This constant effort through many generations has doubtless caused them to assume the permanent twist which the joints exhibit in the lobster, and which brings the movable jaw inside instead of outside, as it is in the second and third pairs of walking-legs.

The inner edges of the jaws (it may be either the right arm or the left) bear large, blunt teeth, while those of its opponent are small and sharp. The lobster sometimes anchors itself by the blunt-toothed jaws, which are usually the largest, while it catches and holds its prey with the others. It also uses the large jaws, if necessary, to crush and kill the live prey which is held by the small ones. Most probably, some of the specimens will show a very great difference in the size of the two arms, as it is by no means uncommon for the lobster to lose these appendages and then redevelop them. Dr. Stevenson relates that a lobster taken

prisoner by one of his arms sometimes leaves it in the hands of his astonished captor, and beats a hasty retreat; and that he has also been known to shake off his arms when frightened by a loud noise, such as thunder or the firing of a cannon. Such anecdotes in science-teaching are simply useful as a relief from what ought to be close application to the direct observation of the thing which is being taught.

Not only is there a difference in the size of these appendages, but it sometimes happens that they are much distorted, owing, probably, to injuries received after the lobster moults and before the new shell is formed. Faxon figures and describes a number of these deformed jaws.* It is interesting to observe the strongly-marked tendency possessed by these organs to reproduce facsimiles of themselves. Most of the extra growths have assumed the form of jaws with serrated inner edges, though the teeth are of no use, as both jaws are immovable.

A more remarkable proof of this inherent power is found in several specimens in the museum of the Boston Society of Natural History, in which additional articulated sections have grown out, and true movable jaws have been formed.

These extra growths are the results of disease occasioned by the irritation arising from bites, cuts, etc., but they illustrate the general law of reproduction. In nature the result of extra growth, whether occasioned by such causes, or by a cell dividing, or a branch or an organ budding out, or two bodies uniting "in coitu," is the reproduction of the original image with more or less fidelity, according to the law that *like tends always to reproduce like.* Any dealer in lobsters can obtain these deformed arms, if he chooses to take the trouble.

In front of the large arms are the three pairs of jaw-feet or maxillipeds (Pl. III., *B*, *d* 1—*d* 3). These are well named, for they are transitional forms between the true legs and the mandibles. The third pair (*d* 3) pick up and hold whatever food lies quietly on the bottom, at the same time that the large arms are extended forwards, ready to seize and kill the active prey which comes within their reach. The inner portion of this pair of maxillipeds is edged by two serrated blades which hold the food and assist the jaws in tearing off pieces of the right size. It is then apparently bitten and chewed by the other jaw-feet, by the two pairs of little jaws or maxillæ (Pl. III., *B c* 2; *A*, *c* 1; Pl. IV., Fig. 1, *c* 1), which are perpetually moving; and lastly, by the hard, strong grinders or mandibles. The structure of the maxillæ, however, shows that they are not of any real use in the matter of chewing. Their inner edges are hairy, and not spinous or toothed,

* See article "On Some Crustacean Deformities," in Bulletin of Museum of Comparative Zoology." (Harvard College, U.S.A., 1881.)

or thickened in any way, as would be the case if they were accustomed to such hard usage.

The mandibles, on the other hand, are powerful, trenchant blades, and are placed one on each side of the mouth (Pl. II., Fig. 3, *m*, and Pl. IV., Fig. 1), so that they open laterally instead of vertically. This is necessarily the characteristic of all the opposable forms of the lower animals which are formed out of pairs of appendages. Appendages are normally on the sides, and when brought by function into opposition, and used to cut and grind against each other, they must necessarily move from the sides towards the middle. Taken collectively, the mandibles, maxillæ, and maxillipeds are called the mouth-organs on account of their proximity to that opening, and because some of them do assist in preparing the food which has been found upon the ground, and which has been caught and killed by the big arms. When the closely-applied edges of the mandibles are separated, the interior of the mouth is exposed, and just above it is the soft labrum or upper lip (Pl. II., Fig. 3, *lb*).

In front of and above the mandibles are the long feelers or antennæ (Pl. II., Figs. 1, 2; Pl. III.; Pl. IV., Fig. 1, *a* 2), and next to these the short antennæ (Pl. II., Figs. 1, 2; Pl. III.; Pl. IV., Fig. 1, *a* 1). Lastly, the eyes (Pl. II., Fig. 1) are seen at the end of stout, movable stalks on either side of the projecting rostrum of the carapace.

We have now found fourteen pairs of appendages in the cephalothorax, and the question will very probably arise, Are these appendages borne upon rings like those of the abdomen, and if so, where are the rings? It is evident they are not on the outside, therefore search must be made for them on the inside. Most young people who are carefully studying these papers will be intensely interested in answering this question, and will eagerly remove one side of the carapace, and cut off the feathery gills which obstruct their view, to see whether the walking-legs are fastened to anything they may call rings. They will discover what appears to be, at first sight, a white, thin wall extending along the sides of the cephalothorax, but which, upon closer examination, looks as if it might be made of the lower portions of several rings which have become soldered together. A number of these rings may be counted, if each appendage is carefully examined at the point of its attachment, and afterwards removed.

The great difficulty, at this stage of the investigation, is to lead the student to suspect that these internal rings do not belong to the shield above. That this difficulty may be overcome, let us examine the structure of the carapace. We shall then see that it is a shield formed of the skin folded, and hanging down on either side, so as to cover the cavities in which lie the gills or breathing

organs. This can be done by careful use of the knife, or scissors, in cutting away the pendant sides of the shell, or by using lobsters picked out for the purpose, which have the thinnest and most pliable shells, which can be lifted and bent without tearing or breaking; also by placing a fresh or alcoholic specimen in dilute acetic acid until the chalky parts of the shell have been dissolved. In the latter condition it is easy to lift up the side-flaps of the shield, and show that they are merely lateral folds of skin.

Another point is to observe how all the depressions or sutures in the abdomen run straight across the body to the appendages, and how all in the shield run forward towards the mouth. This is shown most plainly by the central, transverse suture (Pl. II., Fig. 1, *su*), which we observed in the carapace, as mentioned in chapter I., page 42. This suture marks the limit of a ring, and its direction indicates that the ring belongs to one of the pairs of appendages in the forward part of the body near the mouth, and not to any pair immediately below.

Prepare a fresh specimen by cutting through the sternal part of the cephalothorax, between the first and second pair of maxillæ. Pl. II., Fig. 3, *ed*, shows where the separation should be made. Pl. IV., Fig. 1, is a view of the cephalothorax from below. The thoracic appendages have been removed, so that irregular cavities (Nos. 1—9) are seen where the appendages were articulated to the body, *ac* 2 (No. 2) is the place of attachment of the second pair of maxillæ, *ad* 1—*ad* 3 (Nos. 1, 3, 4) of the maxillipeds, and *ae* 1 —*ae* 5 (Nos. 5, 6, 7, 8, 9) of the walking-legs. On the right side the first pair of maxillæ are shown. Pl. II., Fig. 3, shows even more plainly the course of the knife along *ed* and between the cavities representing the first pair of maxillæ (*ac* 1) and the second pair of maxillæ (*ac* 2). When this separation has been made, the carapace may be gently raised and torn off; the appendages belonging to the thorax will then remain attached to the under side of that part, and those belonging to the shield itself will come off with it.

Short Papers and Notes.

On Treating Chicks for Section-Cutting.

WE have cut a great many series of chick sections of all stages, from the unincubated blastoderm to five days' chicks, and have hardened by a great variety of methods, and experimented in various ways upon both staining and imbedding. The best methods

are extremely tedious, but if perfect success results tediousness is by no means a fatal objection. Of all tissues embryonic tissues require the most careful handling. We have had good success by several methods, but we can recommend either picric acid or corrosive sublimate as the best reagents for hardening.

Hardening.

I.—*Corrosive sublimate* is to be used in a saturated solution, the embryo to be left in about one half-hour, then transferred to distilled water, where it may remain one half-hour or a little longer if the chick be of over two days' incubation. The purpose of the water is to thoroughly remove the corrosive sublimate, which has served its purpose in the rapid hardening of the specimen. The corrosive sublimate solution is best made by heating the water containing the salt to boiling, dissolving up as much of the salt as possible. Then the solution should stand till cool. A great deal of the salt will be crystallised out of the solution, but a perfectly saturated solution will result. This is to be used at the temperature of the liquid standing in the room. In hardening, it is always wise to immerse the specimen in at least ten times its bulk of the reagent.

II.—*Picric acid* solution is prepared in a variety of ways. We will give one which is a very good one. Prepare a saturated aqueous solution of the picric acid crystals. Filter the solution and add to it 2 per cent. of strong nitric acid. A heavy precipitate will fall; filter the mixture, which is popularly known as *Meyer's picro-nitric.* It will remain unchanged an indefinite length of time ready for instant use. In practice this is generally diluted by the addition of three parts of distilled water to one of the picro-nitric. A specimen should be left in picro-nitric fluid about three hours. If the chick is old enough so that it is bony anywhere, the picro-nitric should be used full-strength and the specimen remain in it six hours. By this time decalcification will have taken place.

From the water after corrosive, or from the picro-nitric, if that be used, the chick is to be transferred to 30 per cent. alcohol for a quarter of an hour, then to 50 per cent. alcohol for half-an-hour, then to 70 per cent. alcohol. The corrosive specimen, after a couple of changes of the 70 per cent. alcohol, will be ready for staining. The picric specimen must be kept in 70 per cent. alcohol, changed every twenty-four hours, till the alcohol is no longer coloured by picric washed out of the specimen.

Staining.

It is best to colour the specimen in borax-carmine, or Kleinenberg's hæmatoxylin is also very satisfactory, before cutting the

sections. Picro-carmine would be better with picric-acid chicks, if one could be sure of possessing the reagent in the perfect condition, but with borax-carmine there is not the slightest difficulty. The chick should be left twenty-four hours in borax-carmine, then, after a short wash in acidulated 70 per cent. alcohol, it should be transferred to 70 per cent. alcohol.

Imbedding.

The specimen thus hardened and stained is to be imbedded as follows :—1.—Transfer to liberal amount of 90 per cent. alcohol 6—24 hours, according to size. 2.—Transfer to absolute alcohol 6—24 hours. 3.—From the absolute pass into spirits of turpentine, and leave here till no more alcohol can be removed by the turpentine, when saturation is complete, as shown by the absence of current visible about the specimen, as well as by the translucent "cleared" appearance, 6—24 hours. 4.—From turpentine to a saturated solution of paraffin in turpentine, 6—24 hours. 5.—From paraffin and turpentine to melted paraffin, kept at uniform temperature slightly above melting point, 6—24 hours. The kind of paraffin, whether hard or soft, will depend upon the temperature of the room. If the room be cool, then the paraffin must be a soft one ; if the section be cut in a warm room, or in summer weather, the paraffin should be hard.

If the chicks be imbedded in this manner, which is certainly a tedious one, it will give the most perfect results. It is the manner in use in the great laboratories, and the way to imbedding for the wonderful "ribbon method." We have never had any need of a flattener. The chick may now be removed from the melted paraffin and placed in the centre of a block, which is to be allowed to cool. When perfectly cold, the block is placed in the microtome and the tissue will cut as easily as the paraffin. If the temperature conditions be regulated, and the room is neither too warm nor too cold, and the razor sharp, and cut with a straight, not a sliding, motion across the chick, slice after slice may be cut of even thickness and of the same area as the block of paraffin containing the specimen. These slices may easily be kept in their proper sequence and with the right side up, and cemented on the slide for clearing and the cover-glass.

We have already written more on this subject than we at first contemplated, but have said as little as possible to explain this method of section-cutting, which, after several years' experience, we unhesitatingly adopt every day, in spite of its tediousness.—*The American Monthly Microscopical Journal.*

Life in the Formation of the Earth.

When we look at the surface of the earth, the vast strata of rocks and soil, we are not at first thought apt to consider the important part that life, in various phases, has taken in the formation of the visible part of the world as it now stands. To the earth life is indebted for its existence, and to life much of the earth's present form is due. They are and have been interdependent.

As rain falls from the sky, it strikes sometimes upon clay and sometimes upon decaying vegetable matter; but in either case, it eventually sinks deep into the earth, and finally finds its way back to the sea. When it strikes the earth, it has a very slight dissolving power, but, as it sinks, becomes compressed and charged with gases. Even the most insoluble substances can be taken up. Few elements are then free from its power. Charged with the various gases, it dissolves carbonate of lime, to be used in building marine shells, salt for the sea, and substances necessary to the existence of marine plants. Seaweeds having no roots must take elements necessary to their existence directly from the surrounding water. Bromine, iodine, potassium, gold, and silver must all be ready for them when needed, and it is to carbonic acid gas that they thus owe their existence. In the same way, corals or other calcareous structures are directly dependent upon this property of charged water.

The water, passing through limestone rock, dissolves away the carbonate of lime, carries it to the coral polype in the tropical waters, where it is appropriated by the animal, and left, when the creature dies, to be worn away by the waves and partly re-dissolved. What remains is piled up on the shore, where it afterwards forms into hard coral rock. This is the cycle of the carbonic-acid gas, and this the key to the formation of our coral reef, of our limestone and marble. In a similar way chalk has been formed. Various causes may unite to decompose these lime-rocks, and the gas thus set free will aid in another cycle.

Life depends upon the sun for existence, and all life is, either directly or indirectly, made up of energy from the sun. Some of this energy may have come to-day, some ages ago; but no matter when it came, it is solar energy. The beef we eat, the water we drink, simply give up latent heat taken from the sun; and this heat is what works our vital system and supplies us with energy. In other words, we are simply using up stored sunlight. In a given body—a plant, for instance, at the time of its death—there is a certain amount of unused heat, which, if the plant decays, is partly used up in decay. If the plant only partially decays, we have some sunlight or heat stored up for future use.

This is the case of our coal. In ages past—millions of years, perhaps—the solar heat poured down from a cloudless sky upon vast and magnificent forests of trees, which lived and died just as our trees do to-day; but, because they fell in damp places, they only partially gave up their solar heat. Then they became buried and finally transformed into hard mineral. Thus, by some wise provision of nature, we have immense areas of coal, time-stored sunlight, ready for use, and now man is using these masses of coal, and making them give up to him the sunlight which they have so carefully stored up through their vast ages.

There are other ways in which vegetable matter has been accumulating to form part of the earth's surface. At the end of the glacial period, over the north-eastern portion of this country, there were vast numbers of small shallow lakes left, dotting the country here and there. When the frozen mass of snow and ice gradually receded, these were filled with clear, cold water, but the water and the earth about were utterly devoid of life. Soon the southern breezes brought spores and seeds of plants. Then animals came. The water began to fill with life and sediment to be formed on the bottom. Then the moss Sphagnum took root on the banks of these lakes, and, according to its habit, began to grow out on the surface of the water, dropping sediment as it went, and year after year growing further and filling in more and more, until, centuries having passed, the lakes became transformed into swamps of peat. This was the way our swamps were formed, and we have them even now in this same process of formation. In Ireland the far-famed peat-beds are examples. Here, in America, where coal is abundant, we have no need of peat, but when our supplies of coal are decreased we have yet large tracts of peat to depend upon. In New England alone there are 2,000,000 acres of peat-swamp.

In Kentucky there is a curious bed of carbonaceous shale, which, before the discovery of oil-wells, was used for an oil supply. This use is now abandoned, but we may yet have to resort to it again. This shale was once a great Sargassum, seen in the midst of the geological ocean that covered our continent. Just such a bed is being formed in the Atlantic Ocean by the accumulation of vast beds of seaweed beneath the sargassum sea, in the centre of the eddy formed by the ocean currents.

The peat-beds are formed by the dropping down of decaying matter from the surface, but our salt-marshes are formed in just the reverse manner. In these the plants grow from the bottom, while the peat-beds are mainly formed by deposition from the surface. Through some cause or other, by winds or eddies, a sand bank is formed in some sheltered bay or creek. As time passes, this grows shallower, and the surface becomes rich with

decayed matter of both vegetable and animal origin. Soon it is uncovered at low tide, and then we see something green growing upon the highest part. This is eel-grass. Each year the grass dies until a sod is formed, which spreads as the bank becomes elevated, until the top is entirely covered with a layer of rich vegetable matter in a state of decay. Then the salt grass or marsh grass begins to grow, and soon only the highest tides flow upon what a few centuries back was a bank of sand entirely covered with water. This formation, in every stage, may be seen on our sea-coast. Vast areas of this kind of land extend along our entire Atlantic coast, and much of it might be reclaimed at very little expense, as has been done in England to large tracts of salt-marsh.

These are a few of the strata in the earth which are due mainly to life for their present position. There are many others of minor importance, but these few mentioned best illustrate the principle of mutual dependence. When we think of it, we are surprised at the importance of life to the globe. Without its influence, what a barren mass of rocks and soil we should have to live upon! It has shaped the continents, moulded the contours of mountains, and made life easy.—"T.," in *Scientific American.*

An Easy and Effective Method of Cleaning Diatoms.

Coarsely powder your diatom-bearing earth, or your dried diatomacea, and mix with *bi*-sulphate of potash. Take a porcelain gallipot, about an inch high, which may be procured at any chemist's. Fill the gallipot about one-third full of the mixture of diatoms and bi-sulphate; take the tongs and set it down among the glowing coals in the stove. The bi-sulphate immediately begins to fuse, and boils up as black as pitch. If the gallipot is not too full, it will not boil over, but rises up and sinks back again and again until, as the sides of the pot begin to turn red, the boiling mass becomes clear, and the bottom of the vessel is seen glowing hot through it. When the boiling ceases, lift out the pot and let it cool. Brush off any dirt or ashes that may be on the outside of the pot, and then put it in clean, hot, *soft* water, and let the contents dissolve, which they will soon do. Pour off the water, and replace with clean, soft water, repeating this several times to get rid of the acid. Then shake up in a test-tube, let the sand settle, and pour off the diatoms, repeating this process, also, if necessary.

In my hands this process has given very fine results, and noxious fumes from boiling acids are avoided.

This process was originally suggested by Mr. G. C. Morris, of

Philadelphia, U.S.; he, however, suggested the use of a platinum crucible, which is quite costly. The porcelain gallipot answers every purpose, while the expense is merely nominal.

A. L. Woodward.

Is the Sun Blue?

A year ago Professor Langley, the distinguished American astronomer, performed an experiment in the theatre of the Royal Institution to explain his startling paradox that the true colour of the sun is blue. He argued that the atmosphere cuts off a large proportion of the blue rays, and that if the observer could get beyond it these would so predominate that the sun would look blue. Last night, in the same place, Captain Abney, in a lecture on "Sunlight Colours," repeated this experiment, adopting Professor Langley's figures with mathematical accuracy, but dispensing with his paper discs, which this lecturer held vitiated the result, and he showed that the colour of the sun was not blue, but very nearly that of the white light to be seen at high elevations in a clear, dust-free atmosphere. When the spectra of sunlight on the Alps, as imagined by Mr. Langley, were compared side by side, they were almost identical. The principle was illustrated by a fine experiment, which Captain Abney called an artificial sunset. Through a solution of hyposulphite of soda a clear circle of electric light was thrown on the screen. The image was like the sun at noon. Then a few drops of hydrochloric acid were added to the solution. This produced a turbid mixture, and, as the turbidity or muddiness increased, first the violet, then the blue, the green, and the yellow rays were successively cut off, the image varying with every gradation until finally there was the dull red of the sun setting in a wintry or a smoky sky. The obscuration caused by a London fog when every light seems a dull red at a short distance, is due to the same cause. Incidentally Captain Abney mentioned that many artists whom he and General Festing had examined in their laboratory did not see more than three-fourths of the red light; but this imperfect perception did not interfere with their use of the colours, for they applied their pigments in the same proportion as they saw them in nature. The effects of clearness of atmosphere on photographic pictures were shown strikingly in Alpine and Egyptian pictures.—*Daily Telegraph.*

Preserving and Colouring Protozoa, etc.

Concentrated Picric Acid, 100 vols.; Sulphuric Acid ($H_2 SO_4$), 2 vols.; distilled water, 600 vols. To this solution, which is used for preserving larvæ of echinoderms, medusæ, and sponges, there

is added, specially for the rhizopods and infusoria, about two or three drops of 1 per cent. acetic acid, to 15 cc. of the liquid. The addition of acid is to preserve nuclei and nucleoli. Thus made, the solution is preferable to osmic acid ($O_S O_4$), for the organisms are perfectly well fixed and permits of more certain colouration. After fixing, the picro-sulphuric acid is removed by alcohol (80 per cent.), which is renewed until the yellow colour has entirely disappeared. It is then replaced by alcohol of 96 per cent., and finally by absolute alcohol. Stain the organism by picro-carmine or an alcoholic solution of safranin (5 grains dissolved in 15 cc. of absolute alcohol), and in a few days filter, and dilute with half its volume of water. This solution is preferable to picro-carmine, and is recommended, not only for preservation of protozoa, but it is good for other microscopic animals—in particular, for *marine* nematodes.—*Zool. Anseiger.* V. A. LATHAM.

The Duration of the Sun.

Professor Sir William Thomson, at the Royal Institution recently, expounded the latest dynamical theories regarding the "probable origin, total amount, and possible duration of the sun's heat." He called attention to the theory of Helmholtz that the sun was a vast globe gradually cooling, but, as it cooled, shrinking, and that the shrinkage—which was the effect of gravity upon its mass—kept up its temperature. The total of the sun's heat was equal to that which would be required to keep up 476,000 millions of millions of millions horse-power, or about 78,000 horse-power for every square metre—a little more than a square yard—and yet the modern dynamical theory of heat shows that the sun's mass would require only to fall in or contract 35 metres per annum to keep up that tremendous energy. At this rate, the solar radius in 2,000 years' time would be about one-hundredth per cent. less than at present. A time would come when the temperature would fall, and it was thus inconceivable that the sun would continue to emit heat sufficient to sustain existing life on the globe for more than 10,000,000 years. Applying the same principles retrospectively, they could not suppose that the sun had existed as at present for more than 20,000,000 years.—*Daily Telegraph.*

Staining Fluid.

In the note on a "Staining Fluid," contributed by R. S., jun., to the February number of the *Scientific Enquirer*, he recommends that the object, after being subjected to a glycerine staining process (Beale's) should be "mounted in *balsam* in the usual way." I would suggest that R. S., jun., had better stick to his authority, and use glycerine as the mounting medium. A. W. L.

Answers to Queries.

137.—Picro-Carmine.—I should have thought any chemist, or rather dealer in microscopical drugs, would have it. Try Mr. Aylward, 160 Oxford Road, Manchester. It is very troublesome to make. However, I will give the recipe for those who like to try it. Make a saturated alcoholic solution of picric acid. To 50 cc. of this solution add 60 cc. of liquor ammonia fort (·880 sp. gr.); evaporate the mixture to dryness, and dissolve the crystals in absolute alcohol, 60 cc. V. A. L.

163.—Erector for Microscope.—Though not in the line of reply called for by the query, it may be of interest to say that an objective screwed into the draw-tube is a most practical contrivance. Of course, nobody, or hardly anybody, will expect to improve definition by passing the pencils of light through an erector of any sort; but almost any objective of from 1 to 3 inch focus may be used at convenience, and will be found adequate for the work usually required from an erector. Objectives of moderate aperture often seem preferable for this use, the cheap solid triplets sometimes sold, answering a good purpose. After long experience with erectors by the best makers, including a "Pigott's searcher," the writer fell into the habit of using only objectives instead. His last "erector" he left with a dealer many years ago with instructions to sell it to anybody at any price, if wanted after the explanation that it was to be sold because the owner preferred a common objective, since which time he has not taken enough interest in the subject to inquire whether it was sold or not.

R. H. W.

166—Cuticle of Leaves.—I do not know Carpenter's or Davis' method, but no doubt it is practice you want. Get 50 leaves and work away at them, and you will get some good cuts before they are finished. B.Sc., Plymouth.

169.—Coarse Adjustment for Microscopes.—The English microscopists are fond of the rack and pinion, continentals of the sliding adjustment. The one is as good as the other, but for a beginner the rack and pinion is probably the easiest to work with.

B.Sc., Plymouth.

169.—Coarse Adjustment for Microscopes.—The rack and pinion, requiring only one hand for its manipulation, and being incapable of running down with an unexpected jerk, is the most convenient and the safest under inexperienced or careless management. When well made it is good, though rather costly; but if of inferior workmanship, it constantly brings to one's mind the temper of the little girl of whom it was said that "When she's

good she's very good, but when she's bad she's horrid." It also often lacks sufficient range of adjustment for low powers, as 4 or 5 inch, unless made awkwardly long for a small stand, for which reason a slip-tube with greater range and quicker motion is sometimes provided in addition. A good rack is doubtless to be preferred on most stands that have also a fine adjustment. The coarse adjustment by a sliding tube moved directly by hand is commended mainly by its cheapness. In really expert hands, however, it is capable of giving a finer adjustment than the best rack, while the awkwardness of its manipulation diminishes rapidly with experience. It is, therefore, applicable to two extremes of use: to instruments in which expense is of more consequence than efficiency, and also to those in which, as in some designed for travelling or laboratory use, moderately fine work is required, although simplicity must be attained by omitting the fine adjustment. R. H. W.

179.—Mounting Insect Organs.—Soak insect or organ in liquor potassæ for a day, or longer if large. Wash and lay out upon the glass slip, arrange in position, and gently press while in the water with another slip. Remove to weak solution of acetic acid for a few hours, or longer, if not desired to finish rapidly. Wash again in clean water, and transfer to glass slip and drop on spirits of wine; arrange the object and put over another clean slip; gently press and lightly fasten with thread; place end down in a small quantity of spirits of wine, and leave for a few hours, which hardens in position. Then remove the thread and gently lift off one slip, the whole still wet with the spirit, when the object will adhere to one of the slips. Drop on absolute alcohol and work the object into centre of slide. Then apply oil of cloves, and in a few hours the object will be ready for balsam to finish. The slides are improved if put away for a month or two to dry, but if put in a warm place they will be ready for finishing in much less time. For this purpose I generally use shellac cement and finish in any other colour desired. C. D. H.

186.—Cutting a Hole in Plate-glass.—The only *sure* method is by drilling with a circular drill, moistened with turpentine, or better still with a copper tube, run at high speed, and fed with emery. These methods, however, are not at the disposal of every amateur, and a good hole may be punched without much risk of breaking the glass, by first marking round the hole to be made with a diamond. Then get "two centre punches," ground to true points, grip one in a vice tightly, place the centre of the marked place on it, and tap the other side of the glass with the second punch, held in the right hand, supporting the glass with the left. In this way, by cautious tapping right over the point of the under

punch, you gradually peck a hole through, which is easily enlarged by proceeding carefully. Finish off with a round file. I succeed in making a good hole 9 times out of 10. J. W. G.

188.—Growth of Flies.—Flies do not grow after reaching the mature state. Is "B. B. B." sure that the flies are the same species? I should say it is extremely improbable. H. P. F. G.

188.—Growth of Flies.—Insects which have attained the imago state *never* grow any more, the growing being performed in the former stages and being partly determined by the amount of food, etc. It must be borne in mind, however, that there are several different species of flies, which appear to the careless spectator to be identical except in size. H. G. MONTGOMERIE.

189.—To find Amœbæ.—Dr. J. E. Taylor's simple device for catching Amœbæ may be of use. He lowers an ordinary glass trough to the bottom of the fresh-water aquarium, and when the trough has been immersed about twenty-four hours, on being carefully brought up numerous Amœbæ will be found crawling on the inner surfaces of the glass. (*Science Gossip*, 1886, pp.113—4.)
V. A. LATHAM.

189.—To find Amœbæ.—These *may* be found in sea-water, in fresh and stagnant water, in mud, and in damp earth. The readiest place to find some form or other of Amœba is in slimy matter taken from decaying leaves in stagnant water. Mount in a drop of water. I have found them teeming in pond water, which has been kept for a time; they *may* also be obtained by exposing a piece of raw meat or any other matter covered with a little water to the sunlight until nearly all the water has evaporated. They *may* then be found in the small quantity of water left, or by mincing very small portions of the surface of the meat with water. I write *may* in each case. Amœbæ are very uncertain beings, and we may go for a long time without meeting with any, or at other times have a rich supply. When these fail the student, the white blood-corpuscles will serve very well as a make-shift, and they can always be obtained without difficulty. It is possible that some Amœbæ at least are only stages in the life-history of other organisms! It is impossible to give a *sure* way of finding them.–C.

192.—Painting Iron. For *protecting Iron and Steel from* corrosion (especially when submerged.)—The metal to be protected is first coated with one or two primings of an oxide of a metal electro-positive to iron, upon which any of the ordinary anti-fouling or oxide paints may be applied. These latter always contain the oxide of a metal electro-negative to iron, and this oxide will consequently always be reduced, and the iron oxidised in time. The priming is composed of oxide of zinc or magnesia,

particularly the latter; and this not only protects the iron, but keeps it from contact with the outer coat. It is claimed that something of this kind has always been used whenever painting of iron has been even partially successful; but that the guiding principle—the use in the first place of a material electro-positive to iron—has been overlooked. Red lead as a priming does fairly well for a time, because though lead is electro-negative to iron, it is only slightly so. Better protection is insured by the use of a distinctly basic material. L.

193.—Problem.—The answer to this problem depends on the fact that gasses expand on being treated 1/492 (one four hundred and ninety second) part of their volume for each degree F, or 1/273 part of their volume at O°C = 32° F. Therefore, on cooling a gas to minus 420° F., it will cease to exist as a gas. This point is called the "absolute zero of temperature," and starting from this point, the following law holds good:—"The volume of a gas varies as its absolute temperature."

Now, 50° F. = 460 + 50 = 510° "absolute."
Also, 500° F. = 460 + 500 = 960° "absolute."

1 cubic foot of gas at 50° F. will then become, at 500° F., 1 × 960/510 = 1·882, and as the question infers that the gas remains enclosed in the cubic foot of space in which it was originally confined, the pressure produced will vary as the numbers 1 is to 1·882. So that, if originally the gas exerted a pressure of 1 atmosphere, or say, 15 lbs. on the square inch, it would, when heated to 500° F., exert a pressure of 1·882 atmospheres, or 15 × 1·882 = 28·23 lbs. on the square inch. J. W. G.

195.—Pronunciation of Names.—[In these answers we have used y to represent i long, i for i short; k for c hard; g for g hard; j for g soft; ay for a long.—Ed.]

The correct pronunciation of the words you mention is as follows, although many scientific names are pronounced wrongly by custom, as clem-ay-tis for clem-a-tis, etc.:—Skist, sky-zo-karp, skay-pij-er-us, skay-brid, sis-ti-lus, krem-o-karp (accent on first syllable), sto-ma-ta (accent on first syllable), py-le-o-ry-za (accent on first syllable), hom-o-jen-eus, per-ij-y-nus, ok-toj-i-nus (accent on second syllable), hy-poj-i-nus (accent on second syllable), see-pal, tu-ni-kay-tar (accent on first syllable), spy-cu-lar, or spy-cules. H. S. Montgomerie.

195.—Pronunciation of Names.—[List similar to above, with following exceptions]:—Sist, kre-mo-karp, ho-mo-je-ne-us, perri-jy-nus, ok-to-jy-nus (accent on third syllable), hy-po-jy-nus (accent on third syllable). N. P. F. G.

[For the words in dispute we have referred to Arnold J.

Cooley's Dictionary of the English Language, published by W. and R. Chambers, 1861, and find—shist, ho-mo-je-ne-us, hi-poj-in-us; the other disputed words are not mentioned.—ED.]

196.—Tadpoles.—Tadpoles of the frog and most other amphibians, if stinted in their food, after their exterior gills have disappeared, and before the appearance of the first pair of legs, which is the hind pair in *Anoura* and the front pair in *Urodela*, will remain in the tadpole stage for over a year, as the Axolotl naturally does; but there are many other conditions required to keep them in the tadpole stage. Of these I will mention that they should not be taken out of the water, nor should they have too little food. Of course, if several are put together, and they are half starved, the weaker will be eaten. H. G. MONTGOMERIE.

196.—Tadpoles.—Robert Chambers, in "Vestiges of the Natural History of Creation" (Morley's Universal Library Edition, page 172), says, that when tadpoles were placed in a perforated box sunk in the Seine, light being the only condition thus abstracted, they grew to a great size in their original form, but did not pass through the usual metamorphosis which brings them to their mature state as frogs. J. C.

Queries.

All Questions and Answers should be clearly and concisely written on one side of the paper only, and every question or answer must bear the name and address of the writer. If this is written on the left-hand bottom corner, it will not be published, in which case initials or other signature should appear in he usual place. When more than one answer is sent by the same correspondent, each must be written on a separate piece of paper.

Correspondents, in sending us answers to questions, are desired to commence by quoting the number and title of the question as printed, before beginning their replies.

197.—Berg-Mehl, etc.—Can any of your correspondents tell me where I can obtain Berg-Mehl and diatomaceous earth from Mourne mountains, Richmond, U.S., Barbadoes, etc.?

PARVUS JULUS RUSTICUS.

198.—Diatomaceæ.—Will any of your readers explain fully the chemical action of the different acids and alkalies used in cleaning Diatomaceæ? I am sure I and others would be able to use them to much greater advantage if we only knew "the reason why," instead of being authoritatively directed to boil in this, that, and the other, without a word of explanation.

PARVUS JULUS RUSTICUS.

199.—Arranging Diatoms.—Can anyone tell me how some of our best mounters manage to arrange the diatoms on their slides with such geometrical precision? What microscope do they use, and is a Stevenson's binocular a good one for the purpose?

PARVUS JULUS RUSTICUS.

200.—Dry Rot in Wood.—I shall be glad of information about the fungus which is the cause of dry rot in wood. Is its life-history known, and when floors are attacked by it will thorough ventilation arrest its progress? If not, what is the cure? J. G.

201.—Mites in Cheese.—Will any reader tell me how these are produced? In what manner does the parent mite first discover the cheese? B. C.

202.—Sun and Moon.—I shall be glad if someone will explain to me the cause of the apparent difference of the size of the sun and moon at the time of rising and setting.

YOUNG ASTRONOMER.

203.—Mushroom Spawn.—I always have to buy this for growing mushrooms, and shall be glad if some reader of the *Enquirer* will tell me how to prepare it for myself. FUNGUS.

204.—Camera Obscura.—I am desirous of making one to fix in a room at the top of my house. Will some friend tell me how to go to work, what lenses and mirrors I am to use, and how they are to be fixed? I shall be glad of full instructions. TOM.

205.—Aperture Shutter.—Would any reader explain in as simple a manner as possible the use and *value* of the Aperture Shutter, and of what use in histological investigation?—JUVENILE.

206.—Aphides.—Can any reader name me a book, with price, on Aphides? W. R. W.

207.—Micro-Spectroscope.—Shall be glad of information on the employment of the Micro-Spectroscope, as to whether spectra can be obtained from slides mounted in the ordinary way. J. F.

Reviews.

EASY EXPERIMENTS for Schools and Families. With Home-made Apparatus. By A. R. Horne, A.M., M.D. (Chicago: A. Flanagan. 1887.)

Describes some 150 or more simple and amusing experiments. The apparatus, when required, will be found to be within the reach of most young people. Many of the experiments, and especially those relating to Chemistry, will be found to be instructive as well as amusing.

Journal de L'Industré Photographique. A monthly Journal.

The organ of the "Chambre Syndicale de la Photographie." Price 7 francs per annum. (Published by Gauthier-Villars, 55 Quai des Augustius, Paris.)

The February number contains a report of the monthly meeting of the Syndicate, which was chiefly taken up with a discussion on the right of photographers to reproduce the works of other photographers without their consent. It appears that in France, the "rights of author" lie with the owner of the studio where the negative is taken, and not with the actual operator (who may be only a servant), as is said to be the rule in English law. This number also contains a useful note by M. Chabanon, on the employment of marine glue in repairing and making water-tight the large trays used by photographers in sensitising; he dissolves the glue in a mixture of Chloroform, Ether, and Alcohol.

DRAWING-ROOM CONJURING. Translated and edited with Notes, by Prof. Hoffmann, Author of "Modern Magic," etc. Crown 8vo, pp. viii.—181. (London: George Routledge and Sons. 1887.)

Here we have a lot of information likely to interest our young friends, and of which they will doubtless make good use, to the amusement and perhaps to the bewilderment of their older friends. The book contains 79 illustrations.

TALES FROM CHAUCER, adapted by Mrs. Haweis. Edited by the Rev. Reginald Haweis, M.A. (London: George Routledge and Sons. 1887. Price 3s.)

One of "Routledge's Word Library" series. These books should find a place on every bookshelf.

SOME FINE SLIDES.—Mr. Anderson, of Ilkeston, has sent us six exceedingly well-mounted slides, viz.—Earwig, Garden Spider, Dung-Fly, Mole-Flea (Male and Female on same slide), Ground-Beetle, and Larva of Drinker Moth. We are not sure that we have met with better specimens of whole-insect mounts.

Answers to Correspondents.

[All contributions should be addressed to the Editor of the *Scientific Enquirer*, 1, Cambridge Place, Bath, and not to the London Publishers. MSS. should be written on one side of the paper only, and signed for publication on the right-hand bottom corner. The full name and address of the writer should be placed at the left-hand corner, and when so placed, it will be understood that it is *not* to be published. Contributions SHOULD reach us before the 10th of the month, and cannot be inserted unless we receive them before the 14th.]

F. R. B.—We have not the book to which you refer by us, but we think you have misquoted the third word that you italicise. The lower lip of insects is called the labium, the upper lip the labrum. Read the passage as we produce it here, and you cannot fail to understand it:—"In the Diptera generally, as in the common gnat, the *labium* consists of a long, cylindrical organ with a round top at the extremity; along the upper surface of the *labium* runs a groove which sheathes the other organs of the mouth, viz.—the mandibles, maxillæ, ligula, where it exists, and the LABRUM; all of which are delicate cutting lancets, by means of which the insect pierces its victim and sucks out the juices."

J. C.—Many thanks for your letter.

Sale and Exchange Column.

[All Exchange Notices are inserted free; for Notices of Books or Scientific Instruments or Accessories offered for sale, a charge of 4d. for the first 12 words and 1d. for every succeeding 3 words will be made.]

What offers in cash for English Peregrine Falcon's eggs, taken in Isle of Wight?—H. Purefoy FitzGerald, North Hall, Basingstoke.

For Sale. Violin, Bow, and Case. Good copy of J. Stainer. Trial allowed. £3 the lot, or what offers in exchange?—H. Purefoy FitzGerald.

Mistletoe Berries.—Will give packet of 30 different interesting micro objects, ready for mounting, for 100 ripe berries.—Rev. H. W. Lett, Aghaderg Glebe, Loughbrickland, co. Down.

Grevillea.—Wanted, back vols., either bound or not.—Rev. H. W. Lett, Aghaderg Glebe, Loughbrickland, co. Down.

Coscinodiscus radiatus for diatom, insect, polarising or other non-botanic objects.—G. H. Bryan, Thornlea, Trumpington Road, Cambridge.

Wanted—Re-Agents. Accessories, etc., for Histological work.—Apply, stating requirements, to F. R. Rowley, 60 Lower Hastings Street, Southfields, Leicester.

Microscopical Slips, Thin Covers, Media, Cements, etc., 33 kinds of Labels; samples, 2d. *Unmounted Objects* as fine Polariscopic Horn and Hoof Sections, Insects, Zoophytes, brilliant selected Show Objects from Exotic Lepidoptera, etc.—Chas. Watkins, King's Mill House, Painswick, Gloucestershire.

Wanted, "Sach's Botany," 2nd edition.—J. Boyd, Dean's Bridge, Armagh, Ireland.

About 40 specimens of Rocks, Minerals, and Fossils, correctly named, with localities where found. Also, a number of Scientific and other Books (nothing worse than new). For price, send stamped envelope to S. G. Morris, Science School, Carmarthen.

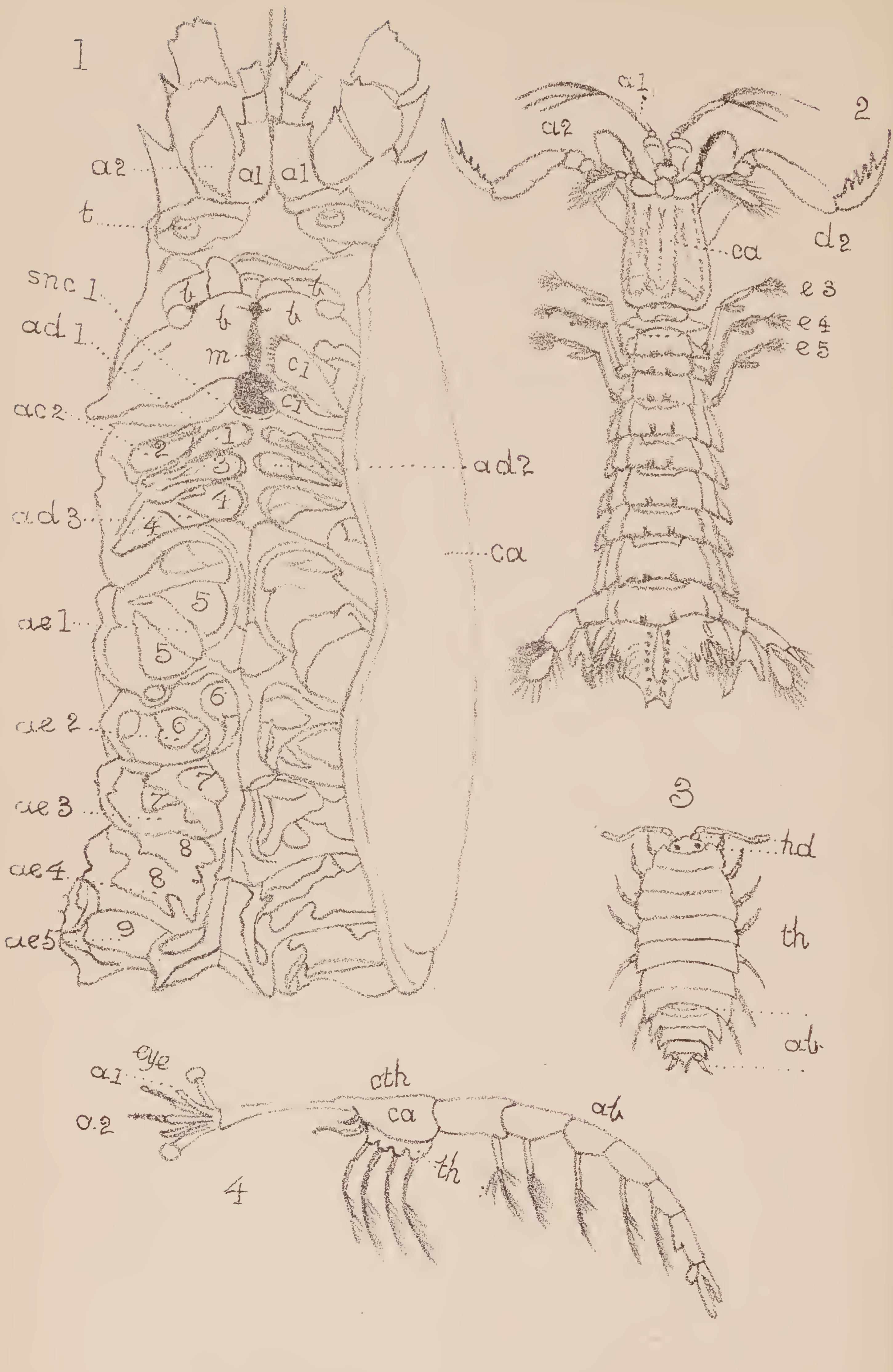
Natural History and Musical Works, Oolitic Fossil Coral, Micro Preparations, in exchange for named cabinet specimens of Diptera and Hymenoptera not in collection.—Chas. Watkins, Painswick, Gloucestershire.

I have some beautiful pieces of Batrachospermum. Those caring for any send small bottle and postage.—M. Farhall, 7 Lorna Road, West Brighton.

Worked Flints, Paleolithic and Neolithic, in exchange for Fossils.—Apply to J. French, Felstead, Essex.

High-class Injections from Monkey, consisting of lip, tongue, liver, lung, spleen, finger. The six slides for 5s.—Henry Vial, Crediton, Devon.

Books for Sale.—Anatomy of Blow-Fly, B. T. Lowe, 8s.; Introduction to Entomology, Kirby and Spence, 1867, 3s.; Introduction to Entomology, Westwood, coloured plates, 1838, 4s.—J. B. Bessell, Fremantle Square, Bristol.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Crustacea.

The Scientific Enquirer.

MAY, 1887.

Crustacea.*

By Alpheus Hyatt.

Chapter III. Plate IV.

As there are different views with regard to the limits of the thorax, it is necessary to state that the space between the first and second pair of maxillæ is membranous entirely across the sternal region. The continuous calcification of the sternal plates which distinguishes the thorax includes the sternum of the second pair of maxillæ, and the little plate (Pl. IV., Fig. 1, *snc* 1) at the posterior border of the mouth is separated by a pliable hinge from the sternum of the second pair of maxillæ. This also affords attachment to the more or less calcified bases of the leaf-like appendages (Pl. II., Fig. 3, *mt*, *mt* 1) of the posterior lip or labium (*lbm*) of the mouth.

Pl. II., Fig. 3, *ed*, is the edge of the thorax; *snc* 1 is the sternal plate of the first pair of maxillæ, which is normally a double plate forking to form sockets for the bases of the metastomata (*mt*), whose broad extremities (*mt* 1) lie upon the mandibles (*b*); *m* is the triangular mouth, and *lb* the labrum or anterior lip, with three pairs of imperfectly-formed plates; *snb* the sternal plate of the mandibles.

Those who consult the English edition of Huxley's "Crayfish," Fig. 39, p. 153, and descriptions, will see at once that he unites the first pair of maxillæ to the thorax, considering the sternal plate to be represented by the first sternum of the united thoracic sterna. This would bring the division of the head from the thorax between the first pair of maxillæ and the mandibles. This is probably an error arising from defective observation. The sternal plate (*snc* 1) can be detected only by careful work on

* From "Guides for Science Teaching." Boston, U.S.A.: Ginn, Heath, and Co.

account of its imperfect calcification in young crayfishes, but is readily seen in the older ones. The separation in the crayfish is also very narrow, a mere line of uncalcified integument, visible under a magnifier. By partially drying, however, and observing from the inside where the calcification is less complete, the plate (*snc* 1) can be more readily observed, and the division also. In this figure the line *mt* ends upon the uncalcified bases of the metastomata, and immediately below this line, where it passes the outer border of the left metastoma, is the hook-shaped, calcified portion or posterior border of the same, which rests upon *snc* 1. *mt* 1 points out the calcified, leaf-shaped, free upper parts of the right metastoma, the membranous part in black. The lines indicating sutures between *snc* 2, *snd* 1, *snd* 2, and *snd* 3, are theoretical, indicating the author's view of the probable position of the sutures; but the line posterior to *sp*, the spinous plate of *snd* 3, was actually visible in one preparation carefully cleaned. The sternal plates are composed of three, and in some cases four, pairs of distinct pieces, the spine or plate *sp* representing the posterior pair, the knobs *kp* the next, and the bridge or beam, *snd*, may be either one or two pairs, according to the segment. From *sp* to *ed* there are no visible sutures in any of the preparations I have yet seen. The metastomata are not regarded as limbs by the majority of naturalists, but this view is not justified by the facts. They are wholly separated from the bases of the first pair of maxillæ, and are independent outgrowths or buds from the integument, as much as any other pair of appendages; and the fact that the parts of the segment to which they must have belonged have disappeared, or cannot be readily found, is an argument of doubtful weight. It is difficult to account for them unless they are acknowledged to be the remnants of a pair of true appendages which have become reduced to their present state by change of function or disuse. This view, however, cannot be maintained without making this series of papers too scientific, and therefore not so useful to the general student.

The separation of the sterna is followed out with more difficulty in the crayfish; and this, as well as its small size and the strong attachment of the last ring of the thorax to the first ring of the abdomen, makes it a more difficult subject for general study than the lobster.

Pl. III., *A*, *B* (see April part), shows the shield and thorax after their separation. The thorax is seen from above. The cavities (Nos. 2—9) are marked by numbers corresponding with those of Pl. IV., Fig. 1. The articular cavities of the first pair of maxillipeds cannot be seen in this figure, but are represented in Pl. IV., Fig. 1, Pl. II., Fig. 3, *ad* 1.

The carapace, thus separated from the thorax, is no longer a

cephalothoracic shield, but a cephalic or head shield.* Having thus artificially separated the consolidated thoracic rings with their appendages, students will more readily understand that the cephalic shield is really composed of a number of rings represented by two out of the three pairs of jaw-appendages, the two pairs of antennæ, and the eye-stalks, five rings in all, bearing their five pairs of appendages.

Five rings when the eye-segment is counted, and four when this is not regarded as a ring. Naturalists are divided in opinion on this subject. The disagreement arises, in my opinion, from the false notions entertained of a crustacean ring. A ring is usually looked upon as a segment which arises independently and prior to the development of the region in which it occurs. According to this view, any portion having a later origin is not entitled to the name of ring. Observations upon the eye-segment and eye-stalks of the lobster tend to prove that the former is not a primitive division of the body, like the other segments, but that it and the eye-stalks are later developments. Whether, however, the portion to which the eye-stalks are attached grows in the same way as the other rings, or in a different way, it is a fact that in the adult lobster there is a distinct eye-segment bearing the distinctly articulated appendages, the eye-stalks. Furthermore, in *Squilla* (Pl. IV., Fig. 2), a crustacean found on the coast south of Cape Cod, there is a distinct, moveable eye-segment. The researches of Professor W. K. Brooks appear to settle this disputed question by showing that of the three anterior segments in *Squilla* the eye-segment arises first, and the two antennal segments afterwards. These three rings are developed, according to the same authority, from the anterior end of the consolidated cephalic region. This looks as if they were quite distinct in their mode of origin from the other rings, though, at the same time, they are true segments, each bearing its pair of appendages. We may therefore count five rings and five pairs of appendages belonging to the cephalic region of the lobster.

We should always carefully distinguish between the stalk itself and the eye. This association is not common to all the Crustacea, but only to one division, as will be seen in *Gammarus* and other lower forms. The large compound eyes are normally only secondary developments, and though functionally more powerful and useful are supplemented by a pair of single eyes, which are found in the young forms, and still exist in some adults, as in the *Limulus*, or horse-shoe crab, of which figures will be given in

* Some naturalists, notably Huxley, are of the opinion that the carapace is under all circumstances a cephalothoracic shield, that portion in front of the transverse or cervical suture belonging to the head, and the part back of it to the thorax.

subsequent chapters, common on our coast. These are the primitive eyes, though superseded and rendered useless in the adults by the functional compound eyes.

That the rings of the head have become consolidated and extended backwards, covering up the rings of the thoracic region, while, on the other hand, the rings of the thoracic region have also been crowded forwards, is proved by comparison with lower forms. Thus, in *Squilla* (Pl. IV., Fig. 2), and especially in *Lucifer* (Fig. 3 of same plate), the forward segments of the thorax are less crowded, and finally in *Nebalia* (Pl. V., Fig. 1) they are not crowded at all. In this remarkable type is seen the typical distribution of the segments, which are described in all the books as if equally characteristic of these forms and of the lobster and higher Decapoda. There are distinctly six appendages to the head, their rings consolidated, and the shield developed backward, but not yet soldered to the thorax. There are also eight appendages to the thorax with every ring definable in the body, and in the abdomen eight rings, six only having appendages. Embryology shows that *Nebalia* belongs to the same large group as the lobster and *Squilla*, and leaves but little room for doubt that the body of the Crustacea is divisible into three regions—the head, thorax, and abdomen. Also, that the two former are concentrated in the Decapoda so as to be almost indistinguishable; and to such an extent that, in the lobster, in place of counting eight rings in the thorax and six in the head, we have to count nine in the thorax and five in the head. The usual mode of stating this in the books leads the general student to look for precisely the same number of rings in the thorax, head, and abdomen in all forms of Crustacea, whereas they vary in the different forms.

Five cephalic rings in place of six have become consolidated, and the lateral and dorsal pieces have spread backwards in the lobster, until they have covered the nine thoracic rings bearing the walking-legs, the maxillipeds, and one pair of maxillæ. A dried and cleaned shell from which the thorax, with the legs, etc., can be removed, will be found useful at this stage of our study of the Crustacea.

Before studying the elements of a ring, which will make the subject of the consolidation of segments clearer, the appendages of the cephalothorax, which still remain in good condition on one side of the body, may be compared with those of the third abdominal ring (Pl. III., *E*), in order to determine whether or not they are built upon the same plan of structure.

For this comparison it would certainly be most natural to begin with the eye-stalks and go backward, or else with the last pair of walking-legs and go forward; but, in either case, there would be much difficulty in recognising the similarity of structure

which really exists, though it is most successfully disguised by both of these pairs of appendages. Now, if the resemblance is less completely masked by any one of the fourteen pairs of appendages, it would be better to begin with that pair wherever it might occur. Just such appendages are found in the third pair of maxillipeds (Pl. III., *B*, *d* 3). Students will recognise the basal section (*h* 1) with the two parts corresponding to the two lobes. The inner lobe has taken the form of a little walking-leg (*h* 3), while the outer lobe has become slender and tapering (*h* 2). A fourth and additional section (*h* 4) is articulated to the basal portion, and extends upward into what is known as the gill-chamber. This section bears one of the feathery gills (*g*).

Examining now the five pairs of walking-legs, it is seen that they represent the inner section (*h* 3), while the outer section is undeveloped. The fourth section (*h* 4), bearing a gill (*g*), is found in all excepting the last pair of walking-legs.

Turning to the second pair of jaw-feet (*d* 2), the four sections are quickly recognised; in the first pair (*d* 1) the fourth section does not bear a gill.

We have now found six gills fastened to six of the thoracic appendages, and we also observe twelve others attached to the consolidated thoracic rings, making eighteen gills on each side. When the animal is walking or feeding, the gills attached to the legs are kept in motion. In this way a greater extent of surface is brought in contact with the water, and the aeration of the blood more speedily effected.

The sections of the second and first pairs of maxillæ have become modified into delicate, leaf-like forms, in which it is not as easy to distinguish the separate parts. Care should be taken in removing the second pair of maxillæ not to injure the spoon-shaped organ (Pl. III., *B*, *c* 2?) attached to each maxilla. This is marked with an interrogation point, as it is uncertain whether it represents the section *h* 4 or the united sections *h* 2 and *h* 4. This organ is a hinged valve, and it pumps the water through the gill-chamber, whereby a fresh supply is induced to flow in under the carapace. In the mandible (*b*) the basal section (*h* 1) is greatly developed, and the inner lobe is represented by the little jointed palp upon its upper side (*h* 3).

Examining the large antenna (*a* 2), it is easy to detect the basal section (*h* 1), with its long, slender, many-jointed inner division (*h* 3) and scale-like outer division (*h* 2). An opening (Pl. IV., Fig. 1, *t*) will be seen on the ventral side of the basal section of both antennæ. These are the outlets of the two large "green-glands" which are situated within the head, and are supposed to perform the function of kidneys. In the little antenna (*a* 1) the inner and outer divisions (*h* 3, *h* 2) are similar in general appear-

ance. Lastly, the eye-stalk (*ey*) is supposed to represent the basal section (*h* 1), the three appendages borne on this not being developed.

On the upper side of the basal section of the little antennæ are the ears of the lobster (Pl. III., *A*, *a* 1, *ear*). These organs are detected externally by a small oval space of a clearer aspect than the rest of the section. This space is protected by hairs, and when these are scraped or cut away an opening is seen on the upper inner edge, through which a bristle may be passed into the interior.

If, now, the soft, external membrane covering the oval space is carefully removed, together with the calcified portion of the section and the muscles beneath, a white, semi-transparent sac is seen, in which one end of the inserted bristle will be detected. Opening this sac, it is found to contain very small grains of sand with other foreign matters and a thick fluid. A projecting ridge is also observed, covered with fine hairs, which are connected at their bases with branches of the auditory nerve. A sound-wave sets the sand particles in motion, the vibrations affect the hairs, and the impressions of these vibrations are conveyed along the auditory nerve to the brain.

So far, we have discovered, in spite of excessive growth and differences of position on the one hand, or of non-development on the other, one plan common to all the appendages.

The resemblance existing between the appendages arranged along an axis like those of the lobster is known as serial symmetry, and one appendage can be called the serial homotype of another, and the leg of one side can be called the lateral homotype of the same organ on the other side. The lobster's appendages and rings are also excellent illustrations of what naturalists mean by the use of the word homologous; they mean organs which, in different animals, are similar in position with relation to each other and in the elements of their structure. Thus the antennæ and mouth-parts in *Nebalia* (Pl. V., Fig. 1), *Branchipus*, and Lobster (Pl. III.) are all respectively homologous to one another, or the corresponding abdominal appendages, or the stalks of the eyes, but these last are not homologous with the sessile eyes of the *Gammarus* or of the *Limulus* (Pl. V., Fig. 8). The compound eyes themselves are not in the same relative positions in all Crustacea, so far as we know, and they on this account are considered as homologous organs provisionally, whereas the primitive eyes are undoubtedly homologous.

Short Papers and Notes.

Practical Notes on Preparing Palates of Molluscs, Snails, etc.

By V. A. Latham, F.M.S.

The following notes may perhaps be of use to students taking an interest in the study of the tongues, palates, lingual ribbons, or odontophores of this class of animals. The tongue forms the floor of the mouth, and the front part, which is the only part in use, is frequently curved or bent quite over, and its teeth are often broken and blunted. The hinder portion descends obliquely behind the mouth, and its edges are united to form a tube, and enclosed in a membranous sheath, which opens gradually as the part is brought forward to replace the worn portion. The most simple plan to prepare these as microscopic objects is to boil the head of the mollusc in a solution of potash in a test-tube, by which all the parts, with the exception of the tongue and jaw, are dissolved. Care must be taken to thoroughly wash the tongue before mounting. The subjects for dissection should be killed by dropping them into glycerine, and so preserved until they are wanted. The most instructive method is doubtless that of dissection.

The head should be pinned down in a gutta-percha trough, containing water enough to cover the part. The floor of the mouth may be laid open by passing the lower point of a pair of scissors into the mouth, and cutting backwards in the middle line to some distance behind the tentacles ; now pin back the severed portions, and, by the aid of a lancet or needle, work out the lingual apparatus. (A glover's needle, *well* sharpened and inserted in a handle, is most useful for such work.) The ribbon should be cleaned by washing with a camel's hair brush, or by soaking in potash water ; if the latter, wash the tongue *well* before mounting. The preparation may be mounted in glycerine, or if intended as an object for the polariscope, it should be mounted in Canada balsam, which medium I generally use. The dissection should *always* be carried on under water, in the usual method, though the mollusc needs but little pinning down. Let the student start with the common periwinkle, *Littorina littoralis*, or, perhaps, better still, with *Patella vulgata*, or Common Limpet.

In the former the lingual ribbon will be found coiled up like a watch-spring by opening the back of the animal, and this place will be found generally the best of all to examine first. In *Patella vulgata* it is only necessary to remove the foot or broad, flat disc

forming the lower surface of the body, when the lingual ribbon is exposed to view. In the Trochuses, and indeed in all the *Scutibranchiata*, taking as an example *T. ziziphinus*, or pearly top, the floor of the mouth must be exposed from above, when the lingual ribbon will be found lying upon it. In the *Buccinum undatum*, or whelk, the trunk contains the whole of the ribbon, and may be seen by opening the back just behind the tentacles.

Snails' tongues are best mounted in a weak form of Goadby's solution, with sufficient pressure to open out the ribbon, but not enough to reduce everything to a dead level (glycerine and water, salt and water, I do not recommend). This shows splendidly under the polariscope.

Glycerine is, perhaps, the best preservative of the animal where only the tongues are wanted; but it leaves the animals very soft, and as it does not harden their mucus at all, they are very slippery and difficult to work upon. The mode of using the tongue can be easily seen in the common water-snails when they are crawling on the glass sides of an aquarium. If you proceed to dissection, and open the head of one of these molluscs—say, limpet—you will find the cavity of the mouth almost filled with the thick fleshy mass, the front of which is protruded in the act of feeding, and on its upper surface, extending along the middle line from back to front, is seen the strong membranous band upon which the teeth are set. The mass itself consists of a cartilaginous frame, surrounded by strong muscles, and these structures constitute the whole of the active part of the lingual apparatus. The situation of the ribbon varies. In the *Acmæus*, for instance, which are closely allied to the limpets, and have shells which cannot be distinguished, the reserve portion (which comes to the front and takes the place of that worn away) of the ribbon has to be dug out from the substance of the liver, in which it is imbedded, that organ being, as it were, stitched completely through by a long loop of it. It might be thought a comfortable reflection that, at all events, one end of the ribbon can always be found in the mouth, but in many cases this is about the worst place to look for it. Perhaps it may appear strange that, in some of the smaller species, with a retractile trunk, a beginner may very likely fail altogether in his attempt to find the mouth. If, however, the skin of the back be removed, commencing just behind the tentacles, there will be very little difficulty in making out the trunk, which either contains the whole of the ribbon, as in the whelk, or the front part of it, as in *Purpura* and *Murex*, where a free coil is also seen to hang from its hinder extremity. Mr. Edwards, of New York, soaks the animal until it dies and decomposes in a strong solution of caustic potash (the strength differs with the species), when it can be readily removed and falls to

pieces. Now place the animal in the potash solution for some days, or boil at once. Wash the ribbon well, place in alcohol, remove from spirit, and boil a short time in turpentine. Then it may be mounted in Canada balsam, or, after the ribbon has been well washed, I place it between two glass slips to dry, but only pass two india-rubber bands over the slips, as the usual clip is too strong and injures the teeth. When quite dry, soak in turpentine in a small saucer. When transparent, transfer to the centre of a deep cell, which I make as follows :—Cut four slips of thin glass, two 7/8ths of an inch long and 1/8th wide, and two 5/8ths of an inch long and 1/8th wide. Cement these to slip with marine glue, etc., so as to make a cell 7/8ths of an inch square. When quite dry, clean off from the inside of the cell all superfluous cement. After it is quite clean, pour in a small quantity of turpentine, but do not allow it to remain longer than two or three minutes; then pour out. Now fill the cell with Canada balsam, and in the centre place the palate of whelk, etc. Moisten one side of a thin glass cover, exactly 7/8ths of an inch square, with turpentine, and drop it on to the balsam, so that all air-bubbles may be excluded from the cell. This is easily done if sufficient balsam has been put into the cell. Dry, clean, and cement as usual. I would recommend the student to read Dr. Alcock's paper in the second volume of the third series of "Memoirs of the Literary and Philosophical Society of Manchester," and McAlpine's Biological Atlas, 7/6 (A. K. Johnson and Co.).

To Change Blue Photo Prints to Brown.

Dissolve a piece of caustic potash, about the size of an ordinary soup-bean, in five ounces of water. It will dissolve in a few minutes. Place your blue prints in this solution, and in a short time they will fade to a pale orange-yellow colour. When all the blue tints have disappeared, wash in clean water. Now dissolve a partly "heaped-up" teaspoonful of tannic acid in about half-a-pint of water. Put your yellow prints into this bath, and they will immediately begin to assume a brown tone. Permit them to remain in the tannic bath until they are as dark as you desire, then take them out, wash well, and dry.—*American Machinist.*

Water-Tight Cement for Aquariums.

The frame of a tank for an aquarium, whether of wood or metal, may be rendered water-tight by a preparation composed of one part powdered resin and two parts, each, of plaster of Paris and litharge, mixed with linseed oil. This cement will be found useful in case of leakage.

An Easy Experiment for Detecting Adulteration of Butter.

Spread the suspicious butter on a piece of white paper, which is then rolled up and set fire to. If the butter is pure, it gives an agreeable odour; if, on the contrary, it is mixed with the fat of animals, it gives off an odour of burnt fat or suet.—*La Science Pratique* (Translated, V. A. L.).

Bleaching Yellow Ivory.

By steeping a little cotton wool in a liquid, made of equal parts of water and alcohol, and rubbing some on the ivory. If this is not sufficient, then try with a solution of one part of chloride of lime in four parts of water.—*La Science Pratique.*

Method for Discovering Bacteria in Water.

Dissolve in 8 parts of distilled water 1 part of sulphate of alumina and 1 part of hydrochloric acid (H.Ch.). To analyse the water, throw in some drops of this solution. Afterwards, add a drop of ammonia and leave to settle. Filter the deposit, and dissolve it in 10 drops of acetic acid. If the water contains bacteria, one would be able to see them under the microscope collected together in one spot (place); on adding a trace of methyl-violet, the infusoria will become stained, and are easily visible.—*La Science Pratique* (V. A. L.).

To Destroy Caterpillars.

Fruit-trees and shrubs may be cleared of caterpillars by sprinkling with a solution of 150 grms. of alum in 20 litres of water. Syringe the *under part* of the flowers as well as *over* them.—*La Science Pratique* (V. A. L.).

Mimicry in Insects.

The beetles and flies of Central America must have learned by experience to get out of the way of the nimble Central American lizards with great agility, cunning, and alertness. But green lizards are less easy to notice beforehand than brown or red ones; and so the lizards of tropical countries are almost always bright green, with complimentary shades of yellow, grey, and purple, just to fit them in with the foliage they lurk among. Everybody who has ever hunted the green tree-toads on the leaves of waterside plants on the Riviera must know how difficult it is to discriminate these brilliant leaf-coloured creatures from the almost identical background on which they rest. Now, just in proportion as the

beetles and flies grow still more cautious, even the green lizards themselves fail to pick up a satisfactory livelihood; and so at last we get that most remarkable Nicaraguan form, decked all round with leaf-like expansions, and looking so like the foliage on which it rests that no beetle on earth can possibly detect it. The more cunning your detectives get, the more cunning do the thieves become to outwit them. Look, again, at the curious life-history of the flies which dwell as unbidden guests or social parasites in the nests and hives of wild honey-bees. These burglarious flies are belted and bearded in the very self-same pattern as the bumble-bees themselves; but their larvæ live upon the young grubs of the hive, and repay the unconscious hospitality of the busy workers by devouring the future hope of their unwilling hosts. Obviously, any fly which entered a bee-hive could only escape detection and extermination at the hands (or stings) of its outraged inhabitants, provided it so far resembled the real householders as to be mistaken at a first glance by the invaded community for one of its own numerous members. Thus any fly which showed the slightest superficial resemblance to a bee might at first be enabled to rob honey for a time with comparative impunity, and to lay its eggs among the cells of the helpless larvæ. But when once the vile attempt was fairly discovered, the burglars could only escape fatal detection from generation to generation just in proportion as they more and more closely approximated to the shape and colour of the bees themselves. For, as Mr. Belt has well pointed out, while the mimicking species would become naturally more numerous from age to age, the senses of the mimicked species would grow sharper and sharper by constant practice in detecting and punishing the unwelcome intruders. It is only in external matters, however, that the appearance of such mimetic species can ever be altered. Their underlying points of structure and formative detail always show to the very end (if only one happens to observe them) their proper place in a scientific classification. For instance, these same parasitic flies which so closely resemble bees in their shape and colour have only one pair of wings apiece, like all the rest of the fly order, while the bees, of course, have the full complement of two pairs—an upper and an under—possessed by them in common with all other well-conducted members of the hymenopterous family. So, too, there is a certain curious American insect, belonging to the very unsavoury tribe which supplies London lodging-houses with one of their most familiar entomological specimens; and this cleverly disguised little creature is banded and striped in every part exactly like a local hornet, for whom it evidently wishes itself to be mistaken. If you were travelling in the wilder parts of Colorado, you would find a close resemblance to

Buffalo hill was no mean personal protection. Hornets, in fact, are insects to which birds and other insectivorous animals prefer to give a very wide berth, and the reason why they should be imitated by a defenceless beetle must be obvious to the intelligent student.—*Cornhill Magazine.*

To Collect the Organisms from Town Water.

Make a small bag of fine cloth, about 3 inches in diameter and 6 inches long, open at both ends. Attach the lower end to the neck of a small, wide-mouthed bottle and the upper end to the tap of the water supply. Let the water run for an hour or more, when the organisms will be found in the bottle, from whence they may be taken for examination.

A Three Years' Sleep.

The Aisne journals report an extraordinary case of prolonged sleep. In the village of Origny, Sainte-Benoit, lives a young girl of the name of Marguerite Bogenval. Marguerite has been in an hypnotic condition for more than three years past. She sank to sleep on the 31st May, 1883, and has not awakened since, nor so much as stirred a finger. She has been kept alive by the administration of milk and highly concentrated beef tea. Despite the most careful attentions of those watching her, she is now emaciated to an extreme degree, and her bones are piercing her skin. She lies perfectly still and rigid, her eyes closed, and her teeth set fast together. A peculiarity of the case is that, in raising one eyelid, and allowing the light to fall upon the eye, a shudder is noticed, followed by the immediate lowering of the eyelid, or an attempt to do so. Marguerite's respiration is perfectly normal in its regularity, and her pulse, though feeble, is not much below the ordinary rate of beats. The greatest interest has been excited in Paris medical circles by the report of this case. The facts have only recently been made public.

The Whistling Tree.

In Nubia there are groves of acacia extending over 100 miles square. The most conspicuous species, says Dr. Schweinfurth, is the *Acacia fistula.* Its Arabic name is "soffar," meaning flute or pipe. From the larvæ of insects which have worked their way to the inside, their ivory-white shoots are often distorted in form and swollen out at their base with a globular, bladder-like gall, about 1 inch in diameter. After the insect has emerged from a circular hole, this thorn-like shoot becomes a sort of musical instrument, upon which the wind as it plays produces the regular sound of a flute. On this account the natives of the Soudan name it the "Whistling Tree."—*Agriculture.*

The Bee's Sting.

From lengthened observations, Mr. F. W. Clarke, a Canadian, has come to the conclusion that the most important function of the bee's sting is not stinging, but its use by that wonderful creature as a tool. Mr. Clarke says he is convinced that the most important office of the bee's sting is that which is performed in doing the artistic cell-work, capping the comb, infusing the formic acid, by means of which the honey receives its keeping qualities. The sting is really a skilfully-contrived little trowel, with which the bee finishes off and caps the cells when they are filled brimful of honey. This explains why honey extracted before it is capped over does not keep well. The formic acid has not been injected into it. This is done in the very act of putting the last touches on the cell-work. As the little pliant trowel is worked to and fro with such dexterity, the darts, of which there are two, pierce the plastic cell surface, and leave in the nectar beneath its tiny drops of the fluid which makes it keep well. This is the "art preservative" of honey. Herein we see, says Mr. Clarke, that the sting and the poison-bag, with which so many of us would like to dispense, are essential to the storage of the luscious product, and that without them the beautiful comb-honey of commerce would be a thing unknown. This is certainly a most wonderful provision of nature.—*Agriculture.*

To Get Rid of Moisture in Dry Mounts.

I have found the following method to be very useful for preventing the above. Melt some hard Canada balsam and FIX the *cover*-glass with it. There being no liquid to evaporate, no moisture can get into the cell. The balsam, when hard, can be coated with brown cement and then with white zinc, etc. V. A. L.

Thermometrical.

To reduce Centigrade degrees to Fahrenheit:—Double the number of Centigrade degrees, subtract one-tenth of the amount, and add thirty-two to the remainder. For temperatures below zero Centigrade, subtract thirty-two.

Answers to Queries.

187.—Angular Aperture.—"Micro." will find a description of several methods of ascertaining the angular aperture of microscopical lenses in "Practical Microscopy," by G. E. Davies, pp. 56 and 234. There is also an excellent article on the subject in the

Micrographic Dictionary. It would occupy too much space in these columns to give the quotations at length. ALCEDO.

193.—Problem.—The full working is as follows :—Co-efficient of expansion of CO_2 (carbonic acid gas) from 0° to 100° C. at constant volume (Steward's heat)$=\cdot3688$, or for each degree Cent. $\cdot003688$, or for each degree Fahr. $(\cdot003688), \times \frac{5}{9}, = \cdot0020489$.

Volume at 50° F=1 cubic foot.

$$\text{,, at } 32^\circ \text{ F., same pressure, } = \frac{1}{1 + (\cdot00205) \times (50-32)} \text{ cub. ft.}$$

$$\text{,, at } 500^\circ\text{, same pressure, } = \frac{1 + (\cdot00205) \times (500-32)}{1 + (\cdot00205) \times (50-32)} \text{ cub. ft.}$$

But if this volume be now reduced to 1 cubic foot, or not be allowed to expand, then the pressure by Boyle's law will be given by the following :—

$$\text{Required pressure}=(\text{atmospheric pressure}) \times \frac{1 + (\cdot00205) \times 468}{1 + (\cdot00205) \times 18}$$

$$= (\text{atmos. press.}), \times \frac{1 + \cdot95888}{1 + \cdot03688}; = (\text{atmos. press.}), \times \frac{1\cdot95888}{1\cdot03688};$$

$$= (\text{atmos. press.}, = 1\cdot889206.$$

The atmospheric pressure is not given; therefore, the final pressure cannot be found in lbs. or inches of mercury (H_g). It is unnecessary to give the last statement of the question, the vessel being supposed to be closed. In the second case, any change in the atmospheric pressure will not affect the result, only the infinitesimal change in the volume of the containing vessel, which may be neglected. We also neglect the change in volume of the containing vessel due to the change of temperature and internal pressure. W. DODGSON, B.Sc. (Lond.), Manchester.

197.—Berg-Mehl, etc.—If your correspondent makes use of your Sale and Exchange Column, he will have no difficulty in obtaining diatomaceous earths—*e.g.*, in the February number. I myself offered some therein. As to "Mourne Mountain" diatomaceous earth, I may mention that the name is misleading—it should be "Lough Mourne." A note of mine on the subject and a reply thereto from Mr. F. Kitton appeared in *Science Gossip*, Vol. XIX. There is a well-known deposit of fossil diatoms at Lough Mourne, in Co. Antrim, while there is nothing of the kind anywhere among the Mourne Mountains, which are in Co. Down. H. W. LETT, M.A.

200.—Dry Rot in Wood.—In reply to J. G., the fungi causing the above are unluckily very well known. The commonest are *Merulius lachrymans*, attacking fir and pine, and *Polyporus hybridus*, attacking oak. He will find descriptions of these in most works on fungi. Once the spores have penetrated the wood, there is as yet, I believe, no cure known, and anyone who dis-

covers an easy, simple, and effective plan, ought to make his fortune. Apparently, the most successful hitherto is Bethell's process, which is saturation with creosote. There are also Boucherie's process, Kyanising, Burnettising, and Payne's process, and no doubt many others. For further information I must refer him to works on building and the preservation of timber.

J. G. P. VEREKER.

200.—Dry Rot in Wood.—Bentley says that "the disease called Dry Rot, which frequently occurs in wood, is especially caused by dampness and the subsequent development of the spores of such fungi as those of *Merulius lachrymans*, *M. vastator*, and *Polyporus destructor*. All these belong to the BASIDIOMYCETES, division *Hymenomycetes*, subdivision *Polyporeæ*. The "Micrographic Dictionary" also mentions *Thelephora pateana*, which is a member of another sub-division of the Hymenomycetes, viz., *Thelephoreæ*. It seems hardly likely that thorough ventilation would *arrest the progress* of Dry Rot, although it would tend to prevent its appearance in the first instance by keeping the wood dry. Creosote is said to be a good remedy. A. W. L.

202.—Sun and Moon.—The difference in the apparent size of the sun or moon is due to refraction of the atmosphere and the varying conditions under which the object is viewed, either near the horizon, or at the zenith. When the sun is near the horizon, as at rising or setting, its rays are much refracted, and the angle it subtends at the eye of the observer is wider than that subtended when it is nearer the zenith; consequently, there is a considerable difference in its apparent diameter. This apparent difference in size is also affected by the greater or less amount of aqueous vapour suspended in the atmosphere. ALCEDO.

202.—Sun and Moon.—The increased size of the sun and moon when near the horizon is only an optical delusion, since the actual measurements of the apparent figure are not greater. It is accounted for thus:—When close to the horizon, these heavenly bodies can be compared with earthly objects whose size is known, and thus the eye imagines them larger than they really appear. When high up in the heavens, there is no earthly object near to compare them with, and so they look less in size. If while close to the horizon, they are viewed through a tube so as to cut off neighbouring objects, they then seem smaller. E. T. S.

204.—Camera Obscura.—"Tom" does not state what description of camera he wishes to fix in a room at the top of his house, whether an ordinary *camera obscura* in a box, or a larger instrument, such as may be seen at most of our watering-places, where the image of outside objects is thrown upon a circular table in a darkened room. Whichever form your correspondent may

wish to construct, he will find ample description in the "Boys' Own Book," article, "Optics," and in almost any elementary work on that subject. ALCEDO.

Queries.

All Questions and Answers should be clearly and concisely written on one side of the paper only, and every question or answer must bear the name and address of the writer. If this is written on the left-hand bottom corner, it will not be published, in which case initials or other signature should appear in the usual place. When more than one answer is sent by the same correspondent, each must be written on a separate piece of paper.

Correspondents, in sending us answers to questions, are desired to commence by quoting the number and title of the question as printed, before beginning their replies.

208.—Suint.—What is suint? I believe it is obtained from sheep. What is its composition? C. M. A.

209.—Peculiar Mineral.—I saw a little while ago an analysis of a peculiar mineral of great value called an "occidental bezoar." Has it any other name? Why its great commercial value? What is it? C. M. A.

210.—Histo-Pathological Work.—Which objectives are the best, more especially for *histo-pathological* work, and which are the best—wide or narrow fields, more particularly in powers of $\frac{1}{4}$-in. and upwards? HISTO.

211.—Re-mounting Slides.—I have a couple of good typical specimens of amyloid degeneration of liver and kidney, stained in gentian violet (is this the same as methyl violet?), which have gone cloudy. They are slightly rung with brown cement, and I think mounted in Farrant or glycerine—the former most probably. Can any reader say how I can best remount them with the least injury to specimens, and oblige? PATHO.

212.—Eggs of Insects.—Will some kind reader who has had experience in the matter tell me of a liquid that will preserve eggs of insects in it without change of colour or form? W. J. C.

213.—Naphthaline.—Have any readers freely used naphthaline for some time in their botanical or insect cabinet-drawers, and found it a certain prevention of mites and mould, with no harmful action to the specimens when in close contact? INSECTA.

214—Rectified Spirit.—To what extent can rectified spirit of wine be diluted with water, and yet perfectly preserve for future examination all kinds of the smaller insects, as diptera, etc.? Also, will methylated spirit do for the above purpose?

FLY-CATCHER.

215.—Collecting Marine Animals.—When on flying visits to the seashore, I desire to bring home for examination and preservation marine worms and similar animals. What fluid will keep them in colour and shape when they are put into it direct from sea-water? RAMBLER.

216—Orange Insects.—In the *Scientific Enquirer*, vol. I., p. 3, is an extract from *Chambers's Journal*, briefly describing these insects, which I have tried in vain to discover. Will any correspondent kindly give me fuller particulars, so as to enable me to examine them for myself, and also mention any book in which I may find them described by name? ALCEDO.

217.—Section Mounting.—I wish to mount some sections of plants. Should I mount two slides of each specimen—one in glycerine or jelly and the other in Canada balsam—what different effects have these mediums on the sections? J. B.

218.—Early Appearance of Lizard.—On Monday, April 4th, which happened to be a beautiful warm and springlike day, set like a jewel in the midst of long-continued and bitterly cold east and northerly winds, I was walking through the charming Ecclesbourne Glen in the neighbourhood of Hastings, when I came across a lizard basking in the sun, which leisurely moved away and hid itself under a clump of grass as I approached it closely. Is not this somewhat early for such an appearance? ALCEDO.

[We are requested to bring forward some of the more important Queries remaining unanswered in our earlier numbers.—*Ed.*]

219.—Hairs of Mole.—Can a reason be given why the hairs taken from the face of the mole, *Talpa Europæa*, polarise, whilst those taken from the body do not? Does the same peculiarity exist in other animals?

220.—Weevils to Mount.—What is the best and most satisfactory medium in which to mount weevils?

221.—Landscape Photography.—Why are the slow-plates, such as are made by Mr. Cadett and other well-known makers, preferred by eminent photographers to ordinary rapid-plates? I can understand that the finer deposit of silver with a slow-plate gives a softer tone, but I have always understood that contrast is what is required for a good landscape photo.

222.—Chloride of Gold and Aniline Stains.—What is the action of chloride of gold on those parts of the section which it does not stain? Although it does not stain every portion of the section, it is quite evident, from the difference of the action of the aniline dyes on those specimens prepared by gold from those hardened in any other manner, that it has some considerable influence upon them.

223.—Blood Corpuscles.—Dr. Carpenter says that "the red blood corpuscles present in every instance the form of a flattened disc, which is circular in man and most mammalia, but is oval in birds, reptiles, and fishes, as also a few mammalia (all belonging to the camel tribe)." Could any readers suggest what difference it makes to an animal whether its blood has circular or oval red blood corpuscles, and why the camel should differ from other mammalia in this respect?

224.—Bromine.—The curious marine worm, *Balano glossus*, gives off a strong odour of bromine. It would be interesting to know or ascertain whether this element is present in larger quantities in this than in other sea-worms.

225.—Parasitism among Marine Animals.—In the extract from *Science* on this subject (see p. 15, Vol. I., of the *Enquirer*), mention is made of the fish which live beneath the umbrellas of the jelly-fish. Surely, these fish would cause great injury to the trailing hydrant; being constantly in contact, the lasso-cells must be burst. Is this the case, or is there some provision of nature to guard against this injury?

225.—Silvering Brass or Copper Tubes.—Would anyone have the kindness to let me know how brass or copper tubes 20 centimetres in diameter and 3 or 4 metres long, might be silvered in the interior by galvanic process, and being used for the conveyance of wine, how long such silvering would last?

227.—To separate Foraminifera from Shale.—Can anyone tell me the best way of disintegrating shale of various degrees of hardness, separating from it the foraminifera and other microscopical fossils it may contain?

228.—Insect Puzzle.—On the Cotswold hills, during the autumn of 1884, I found attached to stems and blades of grass numerous snow-white elliptical cocoons of from 3/8ths to 5/8ths of an inch in length. The outside of these exactly resembles fine cotton-wool, but the inside is of a finer texture. From these cocoons I bred, from April to July, 1885, specimens of a dipteron and two kinds of ichneumons, besides thousands of tiny, pale-brown mites. I am curious to know which of these insects is the host, or if I have bred it. As these cocoons are not uncommon, perhaps some reader interested in the Diptera or Hymenoptera may have worked out their life-history, and will kindly give the name of the insects whose larvæ spin these cocoons. I shall be happy to send specimens of the insects and cocoons to any one who will endeavour to name them. C. J. Watkins.

King's Mill House, Painswick.

229.—Picro-Carmine.—Are sections stained with aniline dyes and picro-carmine affected by Canada balsam in benzole when it is used as a mounting medium?

230.—Atlantic Ooze.—I have a small piece of ooze from the Atlantic (1,600 fathoms), *Challenger*, and should be glad if any reader will tell me how to prepare and mount it. It will *not* stand boiling in any acids to clean, and shaking up by heating in a test-tube does not help. As this piece is very small, I shall be glad of the most reliable method.

231.—Micro-Photographs.—I have several of these on very small beads of glass, and should be glad to know how to mount them for the microscope.

232.—Sieve-Tubes.—I have a slide showing some sieve-tubes running radially to join two vertical columns of these structures. Is not this very remarkable? I find no mention of such a circumstance in Sachs or De Bary.

233.—Double Nose-Piece.—Which of the various changers or double nose-pieces, at a moderate price, is the best for students to use?

234.—Age of Animals.—Few natural-history books, after giving an accurate description of the habits and colouring of a bird or beast, make any allusion to their average longevity. Can any reader supply any information as to the average length of life of some of the more common birds and beasts, wild or domesticated, in confinement or otherwise?

235.—Spiders.—Can anyone give me the most approved methods of preserving spiders as cabinet specimens, in such a manner as to show all the mouth-organs, eyes, spinnerets, etc., and also the way of preparing and mounting similar objects for the microscope?

236.—Preparing and Mounting Zoophytes.—Can any reader inform me which is the best way to prepare and mount zoophytes for the microscope? I have a number of dried specimens, and find great difficulty in spreading out the tentacles so as to show their structure. Are they best mounted in balsam, or dry and opaque?

237.—Grubs in Helix Caperata.—Whilst cleaning some of the above, I found a number of large white grubs, and wherever these grubs appeared the snail was partially eaten. I should say about 50 per cent. of the shells contained these unwelcome intruders. Will some reader tell me what they are? They are probably the larvæ of some fly.

Sale and Exchange Column.

[All Exchange Notices are inserted free; for Notices of Books or Scientific Instruments or Accessories offered for sale, a charge of 4d. for the first 12 words and 1d. for every succeeding 3 words will be made.]

First-rate Binocular, by Beck, with all apparatus and travelling case, in excellent order. Price, 45 guineas; cost £102.—Address Mackenzie, Clark's Library, Coleherne Terrace, Earl's Court, London.

Wanted—Dissecting Microscope, Field's Pattern.—A. E. F., The Vicarage, East Retford, Notts.

Good, named, Mounted and Unmounted Microscopic Objects in exchange for named Cabinet Specimens of Diptera, Hymenoptera, and Hemiptera not in collection.—Chas. J. Watkins, King's Mill House, Painswick, Glo'stershire

Micro-Polariscopic.—Brilliant Crystals of Opianic and Salicylic Acids, Urea Oxalate, 1s. each, 3 for 2s. 6d.—Eddlington, Alton Villas, Arboretum, Worcester.

What offers in cash for English Peregrine Falcon's eggs, taken in Isle of Wight?—H. Purefoy FitzGerald, North Hall, Basingstoke.

For Sale, Violin, Bow, and Case. Good copy of J. Stainer. Trial allowed. £3 the lot, or what offers in exchange?—H. Purefoy FitzGerald.

Mistletoe Berries.—Will give packet of 30 different interesting micro objects, ready for mounting, for 100 ripe berries.—Rev. H. W. Lett, Aghaderg Glebe, Loughbrickland, co. Down.

Grevillea.—Wanted, back vols., either bound or not.—Rev. H. W. Lett, Aghaderg Glebe, Loughbrickland, co. Down.

Coscinodiscus radiatus for diatom, insect, polarising, or other non-botanic objects.—G. H. Bryan, Thornlea, Trumpington Road, Cambridge.

Wanted—Re-Agents. Accessories, etc., for Histological work.—Apply, stating requirements, to F. R. Rowley, 60 Lower Hastings Street, Southfields, Leicester.

Microscopical Slips, Thin Covers, Media, Cements, etc., 33 kinds of Labels; samples, 2d. *Unmounted Objects* as fine Polariscopic Horn and Hoof Sections, Insects, Zoophytes, brilliant selected Show Objects from Exotic Lepidoptera, etc.—Chas. Watkins, King's Mill House, Painswick, Gloucestershire.

Wanted, "Sach's Botany," 2nd edition.—J. Boyd, Dean's Bridge, Armagh, Ireland.

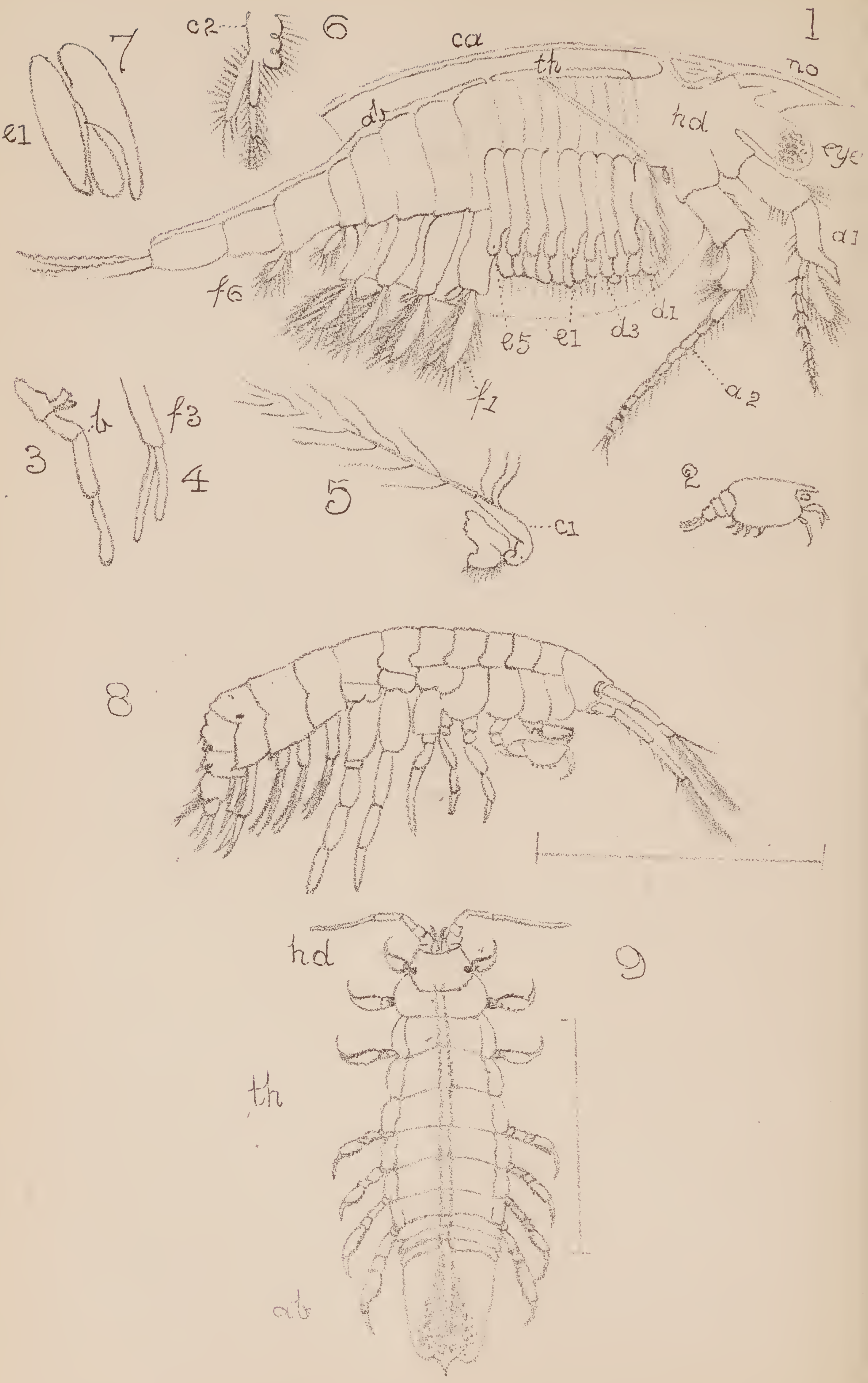
About 40 specimens of Rocks, Minerals, and Fossils, correctly named, with localities where found. Also, a number of Scientific and other Books (nothing worse than new). For price, send stamped envelope to S. G. Morris, Science School, Carmarthen.

Natural History and Musical Works, Oolitic Fossil Coral, Micro Preparations, in exchange for named cabinet specimens of Diptera and Hymenoptera not in collection.—Chas. Watkins, Painswick, Gloucestershire.

I have some beautiful pieces of Batrachospermum. Those caring for any send small bottle and postage.—M. Farhall, 7 Lorna Road, West Brighton.

Worked Flints, Paleolithic and Neolithic, in exchange for Fossils.—Apply to J. French, Felstead, Essex.

High-class Injections from Monkey, consisting of lip, tongue, liver, lung, spleen, finger. The six slides for 5s.—Henry Vial, Crediton, Devon.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The Scientific Enquirer.

JUNE, 1887.

*Crustacea.**

By Alpheus Hyatt.

Chapter IV. Plate V.

IN order to study the elements of a ring, the third abdominal segment should be separated from the others (Pl. III., *E*). Its upper portion, called the tergum (*tg*), is seen to be convex, and much broader than the almost straight ventral beam or sternum (*sn*). The sides of the shell are prolonged downward, forming a double projecting piece called the pleuron (*pr*). In reality, the ring is much more complex in structure, as is shown by Pl. III., *D*, where the tergum, pleuron, and sternum are each seen to be composed of two pieces. Though the sutures marking the limits of all these pieces are not seen in any single ring, yet there are marks on the outside of the shell which show all the divisions. Thus along the middle of the shield is the mark of the median suture (Pl. II., Fig. 1, *sur*) of the tergal plates, and on the ventral side, the middle suture which divides the two sternal plates may be observed. On the abdomen the median suture cannot be detected, but the lateral borders of the tergal plates are well defined, though this is due rather to the lighter colour of these parts than to any other cause.

While we can thus describe a typical ring, it must not be forgotten that in the sterna of the thorax there is more than one pair of plates. In fact, the number of plates is, like other parts, a variable quantity, and in following the text-books this fact should be borne in mind.

Comparing now the thoracic segments with the third abdominal ring, the sterna and pleura are recognised, while the terga appear to be wanting. This, however, is denied by some, who consider that these rings have simply opened along the middle of their tergal portions and spread apart. This, of course, has brought the two halves of each tergum on opposite sides. We

* From "Guides for Science Teaching." Boston, U.S.A.: Ginn, Heath, and Co.

can only account for this splitting of the rings, if this occurred, and their existing forms, by supposing that their dorsal portions were not needed for the protection of the internal organs, as in the abdominal rings, the carapace here being quite sufficient for that purpose.

The consolidation of the rings of the cephalothorax is usually accounted for by the theory of cephalisation or head-making. This theory, originated by Professor Dana of New Haven, assumes that in the higher forms of Crustacea and other types there is a concentration of parts and organs towards the head, and a corresponding series of modifications introduced, enabling these to subserve the purposes of the head better, and dividing them from the walking limbs, etc. Yet this theory does not seem to offer an adequate explanation for all the facts observed. In many Crustacea, Limulus, etc., the cephalic and thoracic appendages have become concentrated around the mouth.

In *Squilla* (Pl. IV., Fig. 2), of which mention has already been made, the head region has been well defined, and consists of three distinct, movable rings, bearing their appendages, the eye-stalks, and two pairs of antennæ. This region is therefore quite independent of the mouth, which lies some distance to the back of it. The mouth, with its appendages, is followed by the thoracic region, while the latter is only in part concealed by the carapace, so that its unconsolidated rings may be readily counted.

Following the thorax is the abdomen, the most conspicuous region of the body, with its large, well-developed swimmerets, which bespeak for *Squilla* excellent powers as a swimmer. It is unfortunate that specimens of *Squilla* cannot be easily obtained, as it is a much simpler expression of the crustacean plan of structure. In the strange type known as *Lucifer* (Pl. IV., Fig. 4), the eye and antennal segments are prolonged very far in advance of the mouth, and show the extreme modifications of this tendency.

Comparing the lobster with the *Squilla* and *Lucifer* type, we find that, in proportion to the size of the two animals, the abdomen of the lobster is much smaller and shorter, and the swimmerets (excepting the last pair) smaller and weaker. The thorax has been carried forward under the carapace, while the walking-legs have become large and strong. The three most essential of the cephalic segments have been carried back towards the mouth, and these, together with the mandibular and maxillary segments, are described as the cephalic region, though, more strictly speaking, they might be named the mouth-region. The mouth, in fact, appears to be the centre around which the cephalic organs are concentrated. We can readily understand that the hunt for food might tend, in the course of many generations, to bring into acti-

vity more and more of the appendages in the vicinity of the mouth, and that this might result not only in a forward concentration of these appendages, but also in such a modification of their structure as would fit them to be more useful servants of the mouth. Yet this effort alone would not be sufficient to account for that exceeding concentration of structure observable in the highest Crustacea. Other effects must be taken into consideration, namely—those which would arise from efforts to walk. It is evident this desire could not be gratified without throwing more work on those appendages which were best suited by their position and structure to bear the weight of the body. The enlargement and increased strength which would surely follow would bring the forward part of the body into greater use, and would render the swimmerets and the abdomen, which are so powerful and necessarily large in a swimming animal, less and less functionally useful, and cause them to decrease in size in proportion as the animal became more and more a walking type. In order that a swimming Crustacean should change into a walking form, the two ends of the body must be shortened, or, in other words, there must be a concentration forwards of the posterior part, and a concentration backwards of the anterior portion, so that the centre of gravity may be brought into proper relation to the bases of support.

This is admirably illustrated by the crabs, as will be seen farther on. Thus it appears that it is not the law of cephalisation, but the effort to obtain food in the most suitable way, and to meet the requirements of the laws of equilibrium, which concentrates the growth in some of the regions and appendages, and warps or suppresses others through disuse. The animal thus becomes able to balance itself upon the smallest number of supports possible for its type of structure, and also acquires the greatest attainable facility in moving and turning on its appendages or supports, a result which is essential to the perfect development of all the higher forms of walking types. The equality of the segments and the elongation of the body in the crawling types like the worms can be strongly contrasted with this concentration. The equality of the efforts made by each ring in the sinuous movements of the body on the surface, or through the mud or ground, is here evidently the cause of similarity, just as the equality of the abdominal rings in the lobster, and their appendages from *f* 2 to *f* 5 inclusive, may be attributed to their performance of identical functions in the act of swimming.*

* For information with regard to the specific effects of use, see the following papers by John A. Ryder :—"On the Laws of Digital Reduction," *American Naturalist*, Oct., 1877 ; "On the Mechanical Genesis of Tooth Forms," *Proceedings of the Acad. of Nat. Sciences, Phila.*, 1878 ; also paper on the same subject in *American Naturalist*, July, 1879.

Owing to the large size of the lobster, only a little care and patience are needed to study the different internal organs. In dissecting the animal, it is desirable to have unboiled specimens. Students should remove, by means of a dissecting-knife or a pair of scissors, the dorsal portion of the carapace, and of each abdominal segment, observing, as they do so, the red skin which covers the body and forms the shell above it. The powerful muscles of the abdomen lie beneath the red skin, extending upward on either side of the cephalothorax. Some time may be spent in examining the different muscles, and in determining how they act. They should then be removed sufficiently to expose the blood-vessels. The heart is a spongy mass, surrounded by a sac, and situated in a hollow space or chamber formed in the posterior part of the cephalothorax. It lies immediately under the skin, and may be distinguished from the other organs by its colour. Five arteries are given off from the heart anteriorly; the middle one passes to the eyes, the next partly to the antennæ, the succeeding two to the stomach and liver. Posteriorly, one artery arises. This branches into two, one of which extends through the abdomen, above the intestine; while the other bends down and connects with the sternal artery which runs along the floor of the body, and cannot be traced till the digestive organs and muscles have been removed. On taking out the heart the sternal artery must be cut. We are then ready to study the digestive organs. A probe may be passed from the mouth into the stomach, which is an extremely interesting organ to examine. It is divided into two parts. The larger or cardiac portion is a sort of mill, where the food is ground by an apparatus familiarly known as "the lady of the lobster." The smaller division, or pylorus, is a gatekeeper in the form of a strainer, which will not permit a single large particle to enter the delicate tube of the intestine. Opening into the pylorus on either side are the large, yellowish-green lobes of the liver. The straight intestine traverses the whole length of the abdomen, and ends in the last segment, like the intestine of the worm.

On removing the digestive system, two large organs remain, which are dark green in the uncooked lobster and red in the boiled specimen. These are the ovaries, which open on the basal joints (Pl. III., *B*, *e* 3, *z*) of the third pair of walking-legs. The eggs come out of these two openings, and are surrounded with a sticky substance, by which they become fastened to the hairs of the swimmerets. Here they remain till the young are hatched. If the lobster is boiled before the eggs are laid, they turn red, and are known as "the coral," from their resemblance to coral beads. The reproductive organs of the male are smaller and longer than those of the female, and open on the basal joints of the last pair of thoracic appendages (Pl. II., Fig. 2, *x*).

Thus, not only the external parts of rings, but nearly all the vital organs of the lobster, are concentrated in the cephalothoracic region. Even the generative organs have been crowded forward, so that the abdomen is really little more than a tail, or muscular organ, for propelling the animal through the water. This being the case, some naturalists prefer to call it the "tail," or "post-abdomen"; but these names involve the students in difficulties when they begin to study the crustacea, so that it seems desirable to retain the name of abdomen, at the same time bearing in mind its tail-like function.

Short Papers and Notes.

Domestic Fire-Extinguishers.

A SIMPLE and inexpensive method consists in filling bottles or other convenient vessels with water or some other liquid, and placing them on racks in convenient places about the building. Most persons are familiar with the much-advertised hand-grenades, so fashionable at the present time; and what is here suggested is an imitation of this system in an economic way. It is usually claimed that these hand-grenades are filled with some mysterious, highly-efficient, fire-extinguishing liquid, and, judging from the high prices at which they are sold, it will not be unreasonable to expect some difficult or costly preparation.

The following recipe produces a composition which is very effective:—Common salt, 19·46; sal-ammoniac, 8·88; water, 71·66. Sal-ammoniac is about as cheap as common salt, so that the cost of the contents of each—say, one-quart size—should be less than one penny. Sometimes the sal-ammoniac is altogether omitted without serious diminution of the efficiency. Our recommendation, therefore, is that every householder, or proprietor of a large building, should provide his own fire-extinguishers. Ordinary beer-bottles are too thick, and resist fracture, even when thrown with force against wood. The flask, therefore, should be of thin glass. It is desirable that the flask, when thrown with force against any object, should fall to pieces. Ordinary corks will answer as stoppers. Then take twenty pounds of salt, ten pounds of sal-ammoniac, and dissolve in seventy pounds (seven gallons) of water, or take thirty pounds of salt and seventy pounds of water. Nearly fill your flasks with this liquid; call it a chemical

fire-extinguishing compound or fluid, if you please; put them in convenient places all over the house or building, and your property will be secured as well as if the outlay were twelve times as great. Should a fire occur, break a bottle or several bottles over it, and the disaster will probably be averted.

When these contrivances are home-made, they cost but little, and they can in consequence be used more freely than if they are bought in the usual way. No large building should be without them, especially those buildings such as hotels, asylums, hospitals, etc., where people sleep in the upper stories, and where loss of or injury to life is possible; and had they not hitherto been sold at so high a price, it is almost certain that they would have become exceedingly popular.—*Chambers's Journal.*

Alteration of Species.

Lobelia inflata seed sown in my own garden, on the richest of ground, where had once been a mortar-bed and pile of sand, changed in the third year to an overgrown *Lobelia spicata*, of two to four feet in height. The whitish, pearly milk-glands at the points of the leaf-serratures were visibly enlarged; the paniculate stems changed to strict and simple ones, except in the upper third of the stem; raceme, long and naked; corolla, four inches or more in length. None of the latter species grow anywhere in the neighbourhood. A removal to a more clay-like soil restored the same perennial roots, the next year, to the annual *Lobelia inflata.* Likewise a pollen-crossed plant of the orange-flowered lily, and *Ixia Chinensis*, or Blackberry lily, produced in the third year bluish-purpled flowers, resembling those of the common blue flag, proving conclusively, to my mind at least, the blue-flag origin of the lily order of plants.—Dr. S. F. Landsey, in *Popular Science News.*

Collecting Marine Diatomaceæ.

Mr. K. M. Cunningham gives the following method as giving especially abundant supplies of Pleurosigma and Coscinodiscus. The back of each one of a peck of fresh oysters is brushed into a basin of water. In this product some tufts of cotton wool are immersed, so that the mass will take fire and burn at a red heat. A still stronger heat, however, must be applied to destroy the animal particles of the oyster, which will inevitably have found their way into the basin. V. A. L.

A Microscopic Advantage.

By inverting a $\frac{1}{4}$-inch objective over the eyepiece of the micro-

scope, an arrangement is produced which immediately gives the images in their proper position, and not upside down, as without it. This is a considerable advantage, because it enables a worker to go straight to the object without the mistakes which so frequently occur with beginners.

New Test for Lead in Water.

I have tried this test, and found it very good; it is used by Mr. W. Byth:—I use 1 per cent. solution of cochineal in proof spirit; 10 drops of this is added to a fluid ounce of the water, contained in a white porcelain dish. If the water is free from Pb., the colour is simply a dilution of the pink tint; but if it contains 1/700,000th part of lead, the tint will be a purplish pink, and if it be as much as 1/70,000th part it will become blue. I consider it one of the most delicate tests we have for lead. V. A. L.

Yew-Poisoning.

The poisonous effects of the yew, both of the fresh and the withered shoots, are due to their containing an active principle—*taxine*—which is a powerful poison. The stones of the fruit, but not the pulp, contain the same principle, and as its effect is to depress the action of the heart, the rapid absorption of the poison into the blood results in death. The contradictory reports as to the effects of swallowing the dangerous forage are due to the stomachs of the animals in fatal cases having been empty, or only partly full, so that the poison was taken rapidly into the system, while in other cases they were full, and the yew having been gradually digested with other food, was therefore unattended with fatal effects. Belladonna proves the best antidote by increasing the action of the heart and the circulation. And see also page 41 *Science Gossip*, 1877. V. A. LATHAM.

Marine Phosphorescence.

The wonders and beauty of the phosphorescence exhibited by the pelagic animals has formed the theme of many writers. Many different pelagic animals are phosphorescent, and the kind of light emitted and the manner of its appearance vary, according to the nature of the animal causing it. Sometimes the sea, far and wide, as far as the eye can see, is lighted up with sheets of a curious wierd-looking light, and wherever the water breaks a little on the surface before the breeze the white foam is brilliantly illu minated. This kind of phosphorescence is due to a minute, glo-

bular, gelatinous animal named *Noctiluca*.* Such displays as above described are comparatively rare, and in order that they should occur, the animals must be present in very great abundance, the sky must be cloudy, and there must be a breeze to agitate the animals, and thus cause them to emit their light more brilliantly. We saw only one such scene during the whole of the *Challenger's* voyage of three years and a half. It occurred in the equatorial Atlantic Ocean, between the Cape Verde Islands and St. Paul's Rocks. So bright was the light that the lower sails of the ship were seen to be distinctly lighted up by the light given off from the broken water thrown up by the hull of the vessel. At other times the water, where disturbed, is seen to be full of small, luminous, scintillating specks. This is the commonest form of phosphorescence in the open sea, and is due to various small animals, principally crustacea, which give out their light by flashes. Some small crustacea are luminous apparently only because they feed on the luminous matter of other animals. The most beautiful kind of phosphorescence is that produced by the curious ascidian colony, *Pyrosoma* (fire-body). These compound colonies are transparent masses of a cylindrical form hollowed out inside into a tubular cavity, open at one end. They are made up of hundreds or thousands of similar animals, all packed in a common jelly, one over the other, in the wall of the tube. Each animal can take in water by an opening situated on the outer surface of the cylinder, and eject it through another opening into the tubular cavity inside it. The animals breathe and feed by thus drawing a stream of water through their bodies, and as the water sent through by all the members of the colony passes out of the opening at the end of the cylinder, the cylinder or whole colony is moved slowly through the water, away from the direction of the opening. A *Pyrosoma* colony, when stimulated by a touch or shake or swirl of the water, gives out a bright globe of bluish light, which lasts for several seconds as the animal drifts past the ship several feet beneath the surface of the water, and then goes out suddenly. Pyrosomas are commonly found of about six or eight inches in length. One was caught during the *Challenger* expedition, in the deep-sea trawl, which was a very giant. It was like a great sac, with its walls of jelly an inch in thickness. It was four feet in length and ten inches in diameter. When a *Pyrosoma* is stimulated by having the surface touched, the phosphorescent light breaks out brightly at the spot irritated. I wrote my name with my finger on the giant as it lay in a tub on the deck, and it came out in a few seconds in letters of fire.—*Science for All.*

* See *Journal of Microscopy and Natural Science*, Vol. VI., p. 7.

Value of Shells.

Since the year 1825, when George Sowerby catalogued and priced the Tankerville collection, shells have much diminished in pecuniary value, and shillings will now generally go as far as guineas did then. This depreciation has chiefly affected the deep-sea shells, which have become more plentiful since the employment of the dredge has been generally introduced, and land-shells, which are mostly procured in abundance when their proper localities are understood. But some shells seem destined to be always scarce, like the Orange Cowry and the *Conus gloria-maris.* No doubt there are "as good fish in the sea as ever came to net," but sometimes they live in inaccessible places. Shell-collectors, like the old Dutch florists, have always set apart a few genera as the special objects of their affection, to which they attach a fanciful value. These are the Cones, Cowries, Mitres, and Volutes, with a few miscellaneous species belonging to other genera, such as the Thorny Oyster, Wentletrap, Carinaria, Harp, and Rostellaria. Most of the stories told about the extravagant prices paid for particular shells are probably apocryphal or grossly exaggerated. It is said that a Parisian "professor of botany" paid 6,000 francs (£240) for a Thorny Oyster (*Spondylus regius*), and that a Dutchman gave *an estate* for a Wentletrap (*Scalaria pretiosa*). Now the *Scalaria* is worth from 5s. to 10s., and the finest *Spondylus* in England was purchased by Mrs. de Burgh for £5. The *Carinaria vitrea*, which, according to Sowerby, once realised 100 guineas, is still worth £12 in the market, and fetched as much as £15 only a few years ago; but the value of fine specimens of this shell is enhanced by its extreme fragility. One of the Orange Cowries in the British Museum was purchased by Mr. Broderip of the late Mrs. Mawe for £30, although it has holes in it made by the natives; and fine specimens are still worth 10 guineas. The *Cypræa leucodon*, in the same collection, is unique, and worth £50; the *C. princeps* was valued at £60; and other examples have realised £40 at the Tankerville sale, and £40 at the sale of Mr. Holford's collection; Mr. Dennison, of Liverpool, had one which cost £35. The specimen of *Cypræa guttata* in the British Museum is valued at £40; and the rare little *Cypræa Barclayi*, when first brought to England, obtained £10; and *Cypræa guttata* has realised sums varying from £12 to £30 within the last ten years, and as the specimens are generally in poor condition, it is certain that fine examples would still command a high price. The cabinet of Miss Saul, of Bow Lodge, is considered to be richer than any other in this group of shells, and the late Mr. Gaskoin, who wrote a monograph of the genus *Cypræa*, had a very extensive series, which afterwards was united to the magnificent collection of the late Mr. Lombe-Taylor, of Starston.—*Cassell's Natural History.*

Answers to Queries.

112.—Remounting Slides.—To remount slides mounted in glycerine or Farrant, cut round the cement, taking care not to crush or tear the section; place in a basin of water, and allow to stand overnight. Then play upon the slide with a gentle jet of water until the cover-glass and section float off, assisting the process, if necessary, with a needle. Pathological slides can hardly be mounted in glycerine media, if only *slightly* rung with cement, as the glycerine would be sure to manifest itself unpleasantly in that case. Avoid remounting in glycerine, if possible, as it is a most uncertain medium and very apt to leak. The other day I saw in the P.M.S. boxes a set of glycerine mounts, and beautiful specimens they were; but glycerine had played the traitor, and I quote an extract from my register to show their condition:—"Both specimen and medium vanished from No. 1 slide. No. 4 slide removed from the box, no doubt in a similar state. Large air-bubbles afflicting slides 3, 5, 9, 10, 12; consequence of using glycerine." There were twelve slides in all, and the form of glycerine used was, I believe, glycerine jelly. A. D.

181.—Eye in Cyclops.—In reference to the question by "Amateur," I may say that the angular spot in the head of Cyclops, which he refers to, is the single median eye. The other sense-organs are the antennæ and antennules, which are also used for swimming. H. Downes.

190.—Aurora Borealis.—Since asking this question, I have been reading interesting accounts of the aurora borealis, and will answer my own question. During the last few years many scientific men have been trying to unravel this mystery. All seem to agree that the aurora borealis is chiefly due to electricity, though many think that other atmospheric vapours play a considerable part in these beautiful northern lights. The needle also shows a different movement in the northern latitudes contrary to that in the southern, which likewise points to electricity, and some writers state that if the display is very intense, the telegraphs are so displaced that no messages can be sent. Some Scandinavian observers in this byeway of physics declare that when the streams of light shoot out from all parts of the horizon a cracking noise is heard, and the whalers also affirm this; but Dr. Sophus Tromholt, of Bergen, and Payer deny this statement. The height of the aurora is also a question not yet satisfactorily answered by the scientific world. Some consider the display is at the altitude of nearly 900 miles, and others as little as seven miles from the earth. Different seasons and different places may account for this great difference in opinion. M. A. Henty.

203.—Aperture Shutter.—In reply to "Juvenile," the Aperture Shutter is an Iris Diaphragm, which is screwed on like an adapter over the objective; its use is to reduce the aperture of the lens so as to gain penetration. "Juvenile" can try its effect by making small diaphragms of blackened card and placing them on the back of his objectives, where they will rest easily. Lenses of medium aperture being most useful for general work, it was thought that this arrangement would enable a lens of large aperture to be used for all purposes. As, however, the Aperture Shutter does not increase the working distance, one of the most valuable qualities of small-angled lenses is lost; also, I do not think the definition of a wide-angled lens, cut down by its means to a small-angled one, is as good as one originally made as a small-angled one. This is very likely caused by the faulty position of the diaphragm, which ought to be placed in its proper optical position, between the lenses, as is done with photographic lenses. This shutter is, however, said to be of use in micro-photography, but I am unable to speak from my own experience in this matter.

As "Juvenile" seems to be studying Histology, I should think that probably the angles of his lenses are already quite small enough, and would not be improved by cutting down, but this he can soon learn by experimenting. J. G. P. Vereker.

206.—Aphides.—The best work on Aphides is "Monograph of the British Aphides," by G. B. Buckton, with 119 coloured plates, 4 vols., 8vo, cloth, Ray Society, 1875, 1877, 1880, 1882, price £3 10s. Some interesting information can also be found in "Figuier's Insect World," price 3/6, Cassell and Co.

Chas. J. Watkins.

209.—Occidental Bezoar.—If C. M. A. will give the *analysis* he saw of an occidental bezoar, it will be easier to reply to his query, as I do not know of any mineral of that name. Often these names are only trade or local names. Its great value is, no doubt, owing to its rare occurrence, though these "great values" must always be taken with the traditional "grain of salt."

J. G. P. Vereker.

209.—Occidental Bezoar.—*Bezoar stones* are described in Thomson's "Dictionary of Chemistry" as "Oval concretions, supposed to be voided in the east from animals of the deer tribe. They usually consist of *lithofellic acid.* In one I found a nucleus of a date stone." "Occidental" implies that the mineral referred to comes from the western world. Dr. Baird says:—"The name is now generally restricted to the calcareous concretions, composed of concentric layers, which are formed frequently in the alimentary tube of herbivorous animals, and which acquire a considerable size. The oriental bezoar, the *Lapis bezoardicus* of Linnæus,

which at one time enjoyed a high reputation as a talisman, is formed in the fourth stomach of the Indian gazelle, *Antilope cervicapra.* It possesses a strong aromatic odour. The substance which enters chiefly into its composition possesses the qualities of a resin. It melts with a gentle heat and burns with much smoke. Similar concretions are found in various other animals, all of which are known by the general name of bezoars. Camel bezoar is much prized by the Hindoos as a yellow paint. The American bezoar is derived from the stomach of the llama, but is not of much repute. They are also found in reptiles and serpents."

H. E. FREEMAN.

210.—Histo-Pathological Work.—It depends a good deal on what kind of work "Histo." wants to use his objectives for. If for ordinary pathological work, a 1/6, or even a *good* 1/4, inch will do, but if for bacteria and germs it will be necessary to possess a 1/8 or, better still, a 1/12. I have a 1/12 by Swift (water immersion) which shows bacteria perfectly. A. D.

213.—Naphthaline.—Several of my butterflies were completely destroyed by larvæ, although the box containing them was thoroughly saturated with the vapour of naphthaline.

G. H. BRYAN, B.A.

213.—Naphthaline.—This is quite harmless to specimens, and much used by professional "naturalists." A. D.

214.—Rectified Spirit.—Methylated spirit will do quite well to preserve any insects, and should not be diluted at all. It might be well to pass the specimens through diluted spirit first, say, for a day. A. D.

216.—Orange Insects.—In *Northern Microscopist,* Vol. III., 1883, there is a short article by Dr. Gooch. V. A. L.

216.—Orange Insects.—Some years ago I hunted over the peel of many oranges, but did not find the coccus such an interesting study under the microscope as described in the extract from *Chambers's Journal.* Nevertheless, I found many in the early stages of transformation, but not very lively, Perhaps the present mode of picking and packing up the oranges so very green may account for the non-appearance of the coccus family, as the little mother coccus may find the fruit is not ripe enough to deposit her eggs on the peel before the oranges are sent off to England.

M. A. HENTY.

216.—Orange Insects belong to the numerous family of scale insects, or mealy bugs, of which there are many curious examples to be found on English plants. They are amongst the most hurtful of insects in gardens and hothouses. They are very small, but when they take possession of a plant or tree its death is almost

certain. The species that infest the orange is called *Coccus Hesperidum.* At times the orange crop has been an almost total failure owing to the ravages of these pests. Some of the cocci, however, furnish products of great commercial value. Cochineal is derived from *Coccus cacti.* At first Mexico alone produced this insect, and it was one of the most productive sources of riches of that country, but it has been introduced into the West Indies and many other countries. Besides various dyes obtained from other species, we are indebted to another species, *Coccus lacca*, a native of India, for shellac, which enters into so many manufactures, notably, that of hats, also varnishes, etc. There is a full and interesting account of the mussel scale, *Aspiodotus (Mylilapsis) pomorum*, in Mr. Chas. Whitehead's reports on "Insects Injurious to Hop-Plants, Corn-Crops, and Fruit-Crops," made to the Agricultural Department of the Privy Council. These reports, three in number, were issued last year, and may be obtained of the Queen's printers, Eyre and Spottiswoode, for a few pence. They should be studied by all cultivators of corn and fruit.

H. E. Freeman.

217.—Section-Mounting.—In reply to J. B., the object of mounting is to bring out the details of the structure in the most efficient way, and this can often be only done by experience. I should recommend J. B. to get "Davies on Mounting Microscopic Objects," price (if I remember aright) 2s. 6d. As a general rule, glycerine jelly is one of the best mediums for fresh vegetable sections, as it is so easily worked. In the case of wood sections, cuticles, etc., where the polariscope is often used, Canada balsam is very good, its refractive index being about the same as glass. To show pitted structures and surface markings, it is best to mount dry. It is always best to mount objects temporarily in a drop of water for examination, without cementing a cover on, and then to decide what medium is the best to use. Canada balsam will make the object more transparent than glycerine jelly.

J. G. P. Vereker.

217.—Section-Cutting.—If for experimental work, it is always best to mount more than one specimen, to note the various results. In some specimens glycerine brings the details out the best, and in others Canada balsam only those which have been treated with the essential oils, and absolute alcohol can be mounted in Canada balsam. Preparations of green parts of plants in glycerine lose colour. V. A. L.

217.—Section-Mounting.—J. B. will find Canada balsam the best medium for his plant-sections. These show, perhaps, better in glycerine at first, but do not last, the outlines of the cells becoming dazzling and indefinite, and it is utterly impossible to

confine glycerine in any form to any cell yet invented. Canada balsam will answer all purposes if properly used. A. D.

221.—Landscape Photography.—The query on this point is one of those on what may be called the debateable ground of photography, and various ideas on the matter are expressed in the photographic journals. The ordinary rule for exposure is the following :—"Expose for the shadows, and let the high lights take care of themselves." Now, every part of a plate is sensitive to light, the difference being that a rapid-plate is more so than a slow-plate. The result of this is that a rapid-plate is so liable to be affected by a long exposure that the image gets flat from over-exposure, and contrast in the print is deficient, or else the high lights get so dense that there is no detail in them; and this, I apprehend, is the reason why a slow-plate is preferred. There is also a tendency in some rapid-plates to thinness of image; but personally I do not consider this a necessary defect in a rapid-plate. A slow-plate is always easier managed, and the gradation from light to dark easier kept, owing to the very fact of its being slower.

There are, however, plenty of rapid-plates in the market, which, I believe, are quite capable of giving first-rate results in landscape if properly used, and a rapid-plate possesses powers of grasping effects totally impossible with the slower plates, as a landscape is seldom perfectly still, and, of course, for the same exposure a rapid-plate admits of a smaller stop being used, which is often of great use. In photography, one ought always to remember that the "art" consists in choosing the point of view, the "science" in so developing as to bring out the effect to the best advantage. If this can only be done with a large stop and long exposure, then a slow-plate must be used; but I have found in my small experience that a rapid-plate has answered all my requirements.

J. G. P. VEREKER.

227.—To separate Foraminifera from Shale.—In the *Geological Magazine* for 1881, p. 70, there is an account of a method of obtaining fossil entomostraca from shale, which will, no doubt, answer just as well for forams. In fact, forams are found mixed with the entomostraca when they are contained in the matrix. "Having collected ten or twelve pounds of decomposing shale, it was carried to the nearest water and washed in a small riddle (1/8-in. mesh) into a buckram bag three ft. long and ten in. wide. It was then further washed in the bag until most of the mud had been carried away, leaving only a few ounces of material. At home it was dried, boiled for half-an-hour, and then washed in a basin until all the fine mud was gone. The washed material, being dried, was then passed through four fine sieves, the meshes of which ranged from 1/16th to 1/60th of an inch. The finer sift-

ings were then searched under the microscope and the coarser with the naked eye." This is taken from my note-book, and, if I recollect rightly, is a good deal condensed. For the full account, refer to the magazine and page quoted. A. D.

229.—Picro-Carmine.—Sections stained with picro-carmine and aniline dyes are generally mounted in Canada balsam thinned with benzole. The *modus operandi* is as follows after the staining is finished :—

Picro-Carmine.—(1) Wash rapidly with 50 per cent. alcohol. (2) Soak in an alcoholic solution of picrate of ammonia for about an hour ; then in a fresh solution of picrate of ammonia for the same time. (3) Transfer to absolute alcohol for a minute. (4) Transfer to oil of cloves or oil of capejut for ten minutes. (5) Transfer to benzole for five minutes. (6) Transfer to Canada balsam in benzole and mount.

Aniline Dyes in Alcohol.—(1) Shake in absolute alcohol for a few seconds. (2) Put in oil of cloves (or capejut) for ten minutes. (3) Put in clean oil of cloves (or capejut) for five minutes. (4) Transfer to benzole for five minutes. (5) Mount in Canada balsam, softened with benzole. I have not used oil of capejut myself, but Davis recommends it as cheaper and better than oil of cloves. The above plans are those given by Dr. Beatty and Mr. Davis. J. G. P. Vereker.

230.—Atlantic Ooze.—This may be cleaned by boiling in a weak solution of caustic potash for a few minutes. It must then be washed in water (which should be distilled, or anyhow free from lime) till the potash is removed, and if the foraminifera are mixed with fine mud, this should also be washed away. The potash, however, destroys *diatoms* if present. This plan is recommended by most writers, but I have not tried it with the ooze myself. It answers well in the case of many similar deposits.
G. H. Bryan, B.A.

Queries.

All Questions and Answers should be clearly and concisely written on one side of the paper only and every question or answer must bear the name and address of the writer. If this is written on the left-hand bottom corner, it will not be published, in which case initials or other signature should appear in the usual place. When more than one answer is sent by the same correspondent, each must be written on a separate piece of paper.

Correspondents, in sending us answers to questions, are desired to commence by quoting the number and title of the question as printed, before beginning their replies.

238.—Mounting without Pressure.—I have recently been rather favourably impressed with some slides I saw mounted as

above, the cover-glass being placed on three small white-glass beads which were attached to the slide. Will anyone oblige me with the method from the first to last stage—viz., how are they fastened on? whether the Canada balsam is run in after the cover-glass has been fastened on, or before? and how is it prevented from running all over the slide? A. B.

239.—Mounting Sections of Seeds.—What is the best medium for mounting sections of seeds? Should they be stained, and what preparation do they require? J. B.

240.—Paraffin and Chloroform (Bütschli's formula).—*Biol. Central*, Vol. I. (1881), pp. 591—2; *J.R.M. Soc.* (new series), Vol. II., p. 708. Not having either of these works at hand, can anyone kindly oblige me with the meaning of the following:—A solution of paraffin (? melting point) in chloroform, saturated at *ca* 35°. What is the given melting point, and also meaning of *ca*? ENQUIRER.

241.—Hardening Tissues.—In looking over the methods of hardening given in most books on the subject, I find a great deal of difference of opinion as regards placing the tissues in spirit AFTER WASHING directly on removal from the chromic acid or Müller's fluid. Which is the correct method? To WASH the tissue, and place in spirit, to get rid of the hardening agent; or ONLY to *place* it in spirit diluted with water, without washing the same? HISTO.

242.—Cement for Glycerine Mounts.—What is the best cement for sealing covers of objects, mounted in glycerine or Farrant, without a cell? W.

243.—Cleaning Diatoms.—Again a question on this well-worn subject! But the enquirer would be glad of information how to obtain diatoms PERFECTLY free from earth and other impurities. We have frequently succeeded in cleansing them, but have almost always failed in separating them from the muddy and siliceous particles by which they are generally surrounded. J. A. D.

244.—Mosses, Mounted Slides.—I shall be grateful for a few hints on mounting, with names of books and price, or any other information on the same. CAPAX.

245.—Mounting Infusoria.—Will any of your readers kindly give me a receipt for making cells for mounting Infusoria, and also for fastening on the thin glass cover? R. F. A.

246.—Mounting without Pressure—Can any readers of the *Scientific Enquirer* give me particulars of the easiest and shortest process by which the heads of insects, etc., are rendered sufficiently transparent to enable their internal structure to be exhibited when mounted without pressure? I have a slide of the

Blow-fly so mounted, and which shows the mouth-organs and œsophagus most clearly. AMATEUR.

247.—Salivary Glands of Cockroach.—What is the method to obtain these glands, and mount for examination to illustrate Miall and Denny's paper in *Science Gossip*, 1884, for a student of insect preparations? H. B.

248.—Aquaria.—Could any of your readers tell me how often it is necessary to clean out an aquarium, and how many fish, snails, and weeds are necessary? T. B.

249.—Mounting Dried Insects, etc.—Will any reader say whether specimens of worms (very small), beetles—parts of them, as the head, etc.—from, say, America, and which have died during the voyage across, can be made use of by soaking in spirit, liq. potassæ, and turpentine, for microscopic objects? A. V.

250.—Lemna.—Can any reader give the names of any works or papers on the British Lemna of late years? A. L.

251.—Insect Dissections.—Will any of your correspondents tell me if there is any work specially treating on this subject, and on their preparation for examination under the microscope? I wish to know what are the instruments to be used, say, to dissect and mount a crane-fly, and what powers to employ, whether a compound or simple microscope. G. H. J.

252.—Pineal Gland as proved to be the Third Eye.—Will any reader assist me by giving the names of papers, journals, etc., of the last year or two containing articles on "The Pineal Gland as being the Third Eye"? I think there is a paper in a back number of the *Quarterly Journal of Microscopical Science* on the same. Any information will greatly oblige. V. A. L.

[*Unanswered Queries from Vol. I.*]

253.—Japanner's Gold-Size.—My gold-size has formed a thick insoluble sediment, and the fluid floats on the top. It is quite useless as it is. Can anyone give a reason and a remedy? It is a year or two old.

254.—Micrometer-Ruling.—Will some reader of the *Enquirer* tell me how to construct a machine for ruling micrometer lines on glass and on metal; also, state probable cost? Perhaps a drawing could accompany the description.

255.—Micro-Polariscope.—The analyser is used in various positions, viz.—above the eye-piece, immediately above the objective, and made to slide in the tube. In either of the first two positions the analyser may be revolved; in the latter, it is permanently fixed. If the polariser revolves, is any advantage gained in revolving the analyser *also*, and if so *why?* Which is the best

position in which to place it? Has cost of workmanship anything to do with its being placed in one position in preference to another?

256.—Electric Light.—How may I construct a battery capable of generating sufficient electricity to feed an electric lamp which will possess sufficient illuminating power to light a room, say, 16 or 18 feet square? Must the battery be brought into the room, or may any length of wire be used? Will anything be gained by using a magneto-electrical machine in conjunction with the battery?

257.—Worms in Oranges.—A short time ago a young friend was eating an orange, and quite by chance divided it. In the interior, the skin at the junction with the centre was all eaten away, and contained about eighteen or twenty small worms, very similar in size and shape to *Filaria sanguinis hominis.* On another occasion, many years ago, I remember that my sister had a similar adventure, which occurred about May. Can any reader inform me what worms they were, and if they have seen any similar cases?

258.—Dessicator for Micro Objects.—What is the simplest and most satisfactory form of dessicator for preparing micro objects which will not bear heat?

259.—Mounting Parts of Insects.—I shall be glad of any information which will enable me to mount for the microscope the head of a spider, fly, or similar object, as an opaque preparation for reflected light, preserving, without contraction, the natural shape and colour of the head and eyes.

260.—Pure Tin Cells, with Caps or Covers.—Will any reader tell me where these may be obtained?

261.—Embryo of Chick.—What position does the embryo of the chick hold to the long axis of the shell? Foster and Balfour's *Embryology* says:—"If an egg be placed with its broad end to the right hand of the observer, the head of the embryo will in nearly all cases be found pointing away from him." In the second vol. of Balfour's *Comparative Embryology*, p. 146, the position of the embryo of the chick is defined thus:—"Its long axis is placed at right angles to that of the egg, and the broad end of the egg is on the left side of the embryo." Can these statements be reconciled, or which is to be accepted?

262.—Coccus Vitis Viniferæ.—Can anyone tell me whether this Coccus (Linn.), so accurately described in White's "Selbourne" (letter 53 to Mr. Barrington), is of common occurrence in England now? White described it as being uncommon.

263.—Stomata in Fossil Plants.—Where can I find any account of stomata having been observed in sections of fossil plants of any palæozoic age?

264.—Chara and Nitella.—What is the best way to prepare and mount chara and nitella to show the *Antheridium*, *Carpogonium*, etc., and where in Lancashire can they be found? In what media should they be mounted?

265.—Vegetable Ivory.—I should be glad of information about the perforation of vegetable ivory by insects, and whether there are any means of guarding against these ravages.

266.—Beetles' Burrows.—On turning over a stone which lay on the road-side in the month of September, I noticed two holes in the ground, similar to those made by dor-beetles under patches of cow or horse dung, and on digging into them I found in each a specimen of *Geotropus stercorarius* Are these beetles in the habit of making burrows under stones as well as beneath dung?

267.—To find Truffles.—Is there any way of finding truffles which are growing in a certain neighbourhood, if you have neither dog nor pig to hunt them?

268.—Who is right?—W. F. Kirby, speaking of Humble Bees (*Bombus*) in the "Young Collector's Handbook to the Order of Insects," says:—"There are no *neuters* among them, but the females differ much in size, some being twice as large as others."

Referring to "British Bees," by W. E. Shuckard, p. 310, we read, "They, the *Bombi*, consist of three sexes—males, females, and *neuters*."

Duncan, in his "Transformations of Insects," referring to the cocoons of Humble Bees, at p. 275, says:—"They are of different dimensions. The smallest, always the most numerous, are the cocoons of *workers*."

Adam White, the author of Part "Insects" in the "Museum of Natural History," speaking of the *Bombi*, says:—"The first nests which they construct are of small dimensions, only sufficient to contain a few cells, in which they rear their *workers*, who assist in the formation of the works necessary to the wants of a large colony."

Will someone who has studied the reproductive organs of the *Bombi* say who is right?

269.—Gall-Flies and their Parasites.—Will someone refer me to a good, reliable, and recent work, in English, with accurate figures of the commoner Gall-flies and their parasites? Also, a work or papers, with figures of the commoner species of Saw-flies and Ichneumons?

Sale and Exchange Column.

[All Exchange Notices are inserted free; for Notices of Books or Scientific Instruments or Accessories offered for sale, a charge of 4d. for the first 12 words and 1d. for every succeeding 3 words will be made.]

In exchange for a few drops of material containing *large* Diatoms, I will send, when mounted, a Selected Slide of Species contained therein. The sand generally washed away in cleaning marine deposits often contains good forms for selecting, and will be gladly received.—G. H. Bryan, Thornlea, Cambridge.

Three gross Micro Slides at 6s. per dozen. Money returned, less postage, if unsatisfactory. Sample slide, post free, 8d. State class of object required.—Downes, 5 Royal Park Road, Bristol.

Kirby's "European Butterflies and Moths," new, bound, approval, 25s.—A. Downes, Bristol.

First-rate Binocular, by Beck, with all apparatus and travelling case, in excellent order. Price, 45 guineas; cost £102.—Address Mackenzie, Clark's Library, Coleherne Terrace, Earl's Court, London.

Wanted—Dissecting Microscope, Field's Pattern.—A. E. F., The Vicarage, East Retford, Notts.

Good, named, Mounted and Unmounted Microscopic Objects in exchange for named Cabinet Specimens of Diptera, Hymenoptera, and Hemiptera not in collection.—Chas. J. Watkins, King's Mill House, Painswick, Glo'stershire

Micro-Polariscope.—Brilliant Slides of Quinic Acid, Opianic Acid, and Carbazotate of Cinchonidine, 1s. each, 3 for 2s. 6d. List.—Adlington, Alton Villas, Arboretum, Worcester.

Micro-Polariscopic.—Brilliant Crystals of Opianic and Salicylic Acids, Urea Oxalate, 1s. each, 3 for 2s. 6d.—Adlington, Alton Villas, Arboretum, Worcester.

Mistletoe Berries.—Will give packet of 30 different interesting micro objects, ready for mounting, for 100 ripe berries.—Rev. H. W. Lett, Aghaderg Glebe, Loughbrickland, co. Down.

Grevillea.—Wanted, back vols., either bound or not.—Rev. H. W. Lett, Aghaderg Glebe, Loughbrickland, co. Down.

Coscinodiscus radiatus for diatom, insect, polarising, or other non-botanic objects.—G. H. Bryan, Thornlea, Trumpington Road, Cambridge.

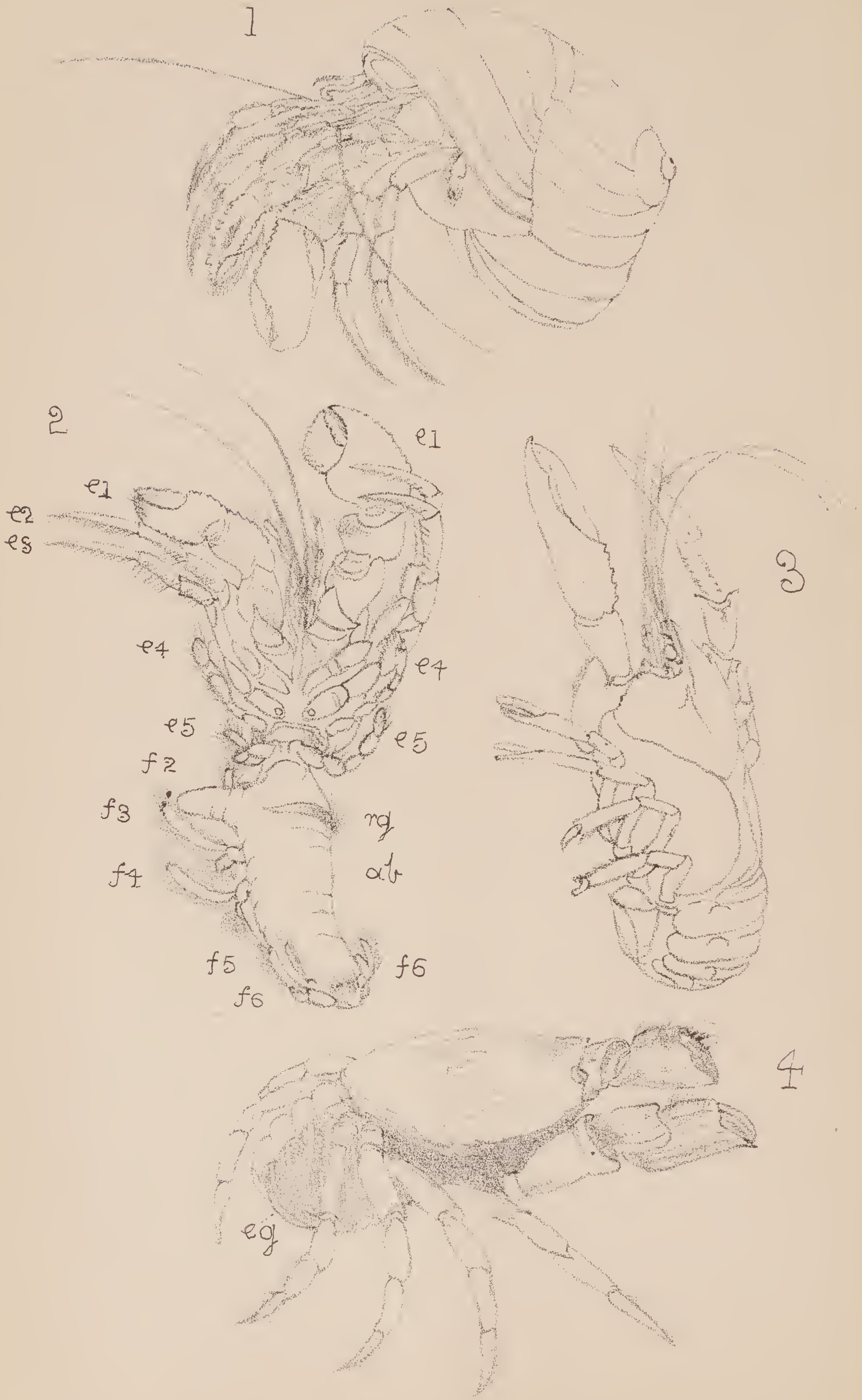
Wanted—Re-Agents. Accessories, etc., for Histological work.—Apply, stating requirements, to F. R. Rowley, 60 Lower Hastings Street, Southfields, Leicester.

Microscopical Slips, Thin Covers, Media, Cements, etc., 33 kinds of Labels; samples, 2d. *Unmounted Objects* as fine Polariscopic Horn and Hoof Sections, Insects, Zoophytes, brilliant selected Show Objects from Exotic Lepidoptera, etc.—Chas. Watkins, King's Mill House, Painswick, Gloucestershire.

Natural History and Musical Works, Oolitic Fossil Coral, Micro Preparations, in exchange for named cabinet specimens of Diptera and Hymenoptera not in collection.—Chas. Watkins, Painswick, Gloucestershire.

Worked Flints, Paleolithic and Neolithic, in exchange for Fossils.—Apply to J. French, Felstead, Essex.

High-class Injections from Monkey, consisting of lip, tongue, liver, lung, spleen, finger. The six slides for 5s.—Henry Vial, Crediton, Devon.



Crustacea.

The Scientific Enquirer.

JULY, 1887.

Crustacea.*

BY ALPHEUS HYATT.

CHAPTER V. PLATE VI.

IN order to see the nervous system of the lobster, all the organs and muscles must be removed. The nerves of the abdomen will be exposed first, as those of the cephalothorax are entirely concealed by a hard, limy secretion, which forms a "false bottom" to this region of the body. When this has been cut away, a double white cord will be seen extending along the floor of the body, and connecting thirteen ganglia. The anterior ganglion is the largest, and is the lobster's "brain." †

Allusion was made to the moulting of the lobster when speaking of crustacean deformities. This process of moulting, or of shedding the shell, is one of the important characteristics of animals encased in articulated armour like Crustacea and Insecta, it being, in fact, the only way in which provision is made for the increase in size of the body by growth. The lobster sheds its shell whenever the old one becomes too small. The number of moults in a given time varies with age, the young lobster shedding its shell oftener, while the large one is supposed to moult, at least, once a year. When the animal is aged, it ceases to moult, and barnacles, mollusks, and other creatures have time to become attached and grow on the shell.

Only three descriptions have been given of the operation, and these were written by naturalists who received their information from unscientific witnesses. The mode of moulting varies, the animal either crawling out of his shell, as the crayfish does, between the carapace and first abdominal ring, or by splitting open

* From "Guides for Science Teaching." Boston, U.S.A.: Ginn, Heath, and Co.

† For a full description of the anatomy of the lobster and crayfish, see Huxley, "Anatomy of Invertebrated Animals"; Huxley, "The Crayfish"; Packard, "Manual of Zoölogy"; Rolleston, "Forms of Animal Life."

the carapace along the middle line of the back (Pl. II., Fig. 1, *sur*). In a specimen observed at the island of Martinicus, off the coast of Maine, the fissure occurred between the carapace and the first ring of the abdomen, as in the crayfish. Through this opening the large arms, the walking-legs, and the whole forward part of the body were drawn. This operation was performed, apparently, without the slightest difficulty. The animal laid on its side, and its tail was bent sharply under the carapace, and no motions of the abdomen were seen. The whole operation was accomplished by the muscles of the forward part of the body, which, gradually bending and bulging more and more outwardly, finally withdrew the cephalothorax completely, and with a motion or two switched off the abdominal casing. The whole time occupied by the moulting did not exceed fifteen minutes. Immediately after the moulting, the size of the large arms was considerably less than the outside measurements of the shell, and so also were all the parts. They were exceedingly hard and firm at first, the watery aspect usually attributed to the newly-moulted Crustacean not appearing until some hours after the shell was actually cast off. The effort to keep the animal alive until his new shell had completely hardened, failed, and at the end of two days he was found dead. The operation of forming a new shell takes probably about a week, though the time is very variable, according to the conditions under which the animal is living. The ease with which the lobster withdraws its body and limbs is owing to the absorption which takes place, especially on the inner sides of the great arms, in an area (Pl. II., Fig. 1, *h*) marked by a series of concentric lines caused by the excess of chitinous matter, and at various parts of the internal rings of the thorax, at the bases of the legs, and along the sutures of the carapace. When this absorption proceeds far enough, the carapace splits under the pressure, otherwise it remains whole, as in the case above described.

Edriopthalmia.

Isopods.

It has been thought best to treat only of those forms which may be easily obtained and may be most directly compared with the lobster in certain logical sequence in this part of our series of papers, and defer even the brief mention which is possible of the lowest forms of the Crustacea until this was finished. The Isopods are found on our coast between tide-marks, and are related to the common "sow-bug," *Oniscus* (Pl. IV., Fig. 3), so often seen in cellars, and common also beneath stones, boards, etc., and other damp places. A species of *Asellus* also occurs in our fresh

water which is like the *Oniscus*, and can be used as a type. They are well represented by the *Idotæa* * (Pl. V., Fig. 9), which is very common in eel-grass, beyond low-water mark. Its body is flattened, and the abdomen and thorax are continuous, and the freely movable rings of the latter may be easily counted. The carapace is reduced to a small head-shield. The appendages have undergone less modification than those of the lobster, and are therefore simpler in structure. The swimmerets are under the abdomen, and the first pair forms a cover for the others. The gills are the two leaves of the swimmerets attached to the bases of the posterior pairs. The seven pairs of walking-legs are very similar to each other, and this is one of the distinguishing characteristics of the order, as might be inferred from its name of *Isopods*, or equal-footed Crustacea. The three anterior pairs are directed forwards, and the remaining four pairs backwards. The Isopods move with the head in advance.

Amphipods.

The largest and finest specimens of the typical Amphipods are those known as beach-fleas, the *Gammarus ornatus* (Pl. V., Fig. 8), and they are found under stones and sea-weed at low-water mark along all our principal beaches. The body of *Gammarus* is composed of a succession of rings, which remind us of the abdominal rings of the lobster, being not unlike these in form, and freely movable upon each other. The seven posterior segments, constituting the abdomen, bear the six pairs of swimmerets. In the figure, five of the swimmerets are represented on the left side, and one on the right.

In front of the abdomen there are seven distinct rings which carry seven pairs of appendages, and in front of these is one pair of maxillipeds. The first ring of the thorax is only represented by remnants of its ventral and lateral portions, but bears the first pair of maxillipeds. The remnants are tucked away between the cephalic shield and the second ring of the thorax, the fifth is extremely small, and shows on the left side just above and are entirely concealed from view until closely looked for. These eight rings and their appendages form the thoracic region. In the *Orchestia agilis*, a species which lives in holes on the beach, the first thoracic ring and the first pair of maxillipeds are clearly seen. In this animal the last three pairs of swimmerets are used for leaping. Both the *Orchestia* and the *Gammarus* leap or swim head first, but while the former can stand upright, the latter, on account of its narrow body, can only swim lying on its side or back down, the appendages being brought closely together by the

* The line on the plate shows the natural size of the species.

lateral compression of the body. The first two limbs of the thorax are used for clasping, a curious jaw being formed by the bending back of the terminal section against the next inner one.

Attached to the bases of the thoracic limbs are the sac-like gills. The carapace is reduced to a small head-shield, as in *Idotæa*, so that the thoracic rings are not covered, and, with the exception described, may be easily counted.

The head looks like one segment, but it carries two pairs of antennæ, one pair of mandibles, and two pairs of maxillæ, which would indicate that the head-shield is really made of five consolidated rings. It will be noticed that the eyes are set in the head, and not borne upon stalks. For this reason, the *Gammarus* and the *Idotæa* are placed among the sessile-eyed Crustacea, *Edriopthalmia*, while the lobster belongs to the stalk-eyed division of the class, *Podopthalmia*.

Podopthalmia.

This general division of the class includes, among the forms already described, *Nebalia* and a host of similar animals, most of them represented by fossils, the genera *Lucifer*, *Squilla*, and the like, of the order *Stomapoda*, as well as the following groups belonging to the order of the *Decapoda*.

Anomoura.

This group, in so far as its range of form and structure is concerned, is in reality equivalent to both *Macroura* and *Brachyura*. The habits of the hermit-crab (Pl. VI., Figs. 1 and 2) are very instructive. The arms are used both for walking and getting food, etc.; the second and third pairs of thoracic limbs for walking alone; and the third pair are crooked and help to hold the animal in the shell, the fourth pair being probably useful in this way also. The segment of the fifth pair is wholly free from the thorax, and seems to belong to the abdomen when viewed from the dorsal side. The abdomen is soft and bag-like. The first ring has no appendages; the second, third, and fourth have limbs on the left side only for holding the eggs during the period of oviferation; *f* 6 in Fig. 2. *f* 6 are the only complete pair, and they are modified into claspers for holding the animal in a shell. *rg* is a hard ridge, which, like the projection on the opposite side, is useful in holding against the columella of the shell. This crab has adopted the curious habit of depending upon the shells of sea-snails for protection, and the softness of the abdomen is due to the effect of the artificial covering of this part, as may be seen by comparison with the less-protected abdomen of *Lithodes*.

Usually, empty shells are chosen, though sometimes other hermit-crabs are killed and the shells appropriated. Two will often desert their old shells, and, making for the same prize, fight desperate duels for its possession. As soon as the house becomes too small for the growing animal, it is deserted, and a larger one selected. It is interesting to watch one of these crabs as it goes about trying on shell after shell, as one does the ready-made coats in a clothing-store until it finds one to fit, when it slips in and closes the entrance with its large arms. The habit of hiding either a part or the whole body in holes arises from the desire for protection, and we can readily understand how such animals, seeking protection, should gradually lose the parts which had been made useless by the new habit, or should modify others which still remained useful, or perhaps even develop new organs. In this connection the great *Birgus*, or Palm-thief, is of special interest. This is a land-crab which inhabits the islands of the Pacific and Indian oceans. Instead of seeking for safety in deserted shells, these crabs make deep holes in the ground, beneath the roots of cocoa-nut trees. In Wood's "Homes without Hands," the crabs are pictured in the act of husking and feeding upon the nuts. The jaws of the first pair of legs do most of the hard work in husking the fruit, and the meat is taken out through the soft "eyes" of the nut by the hinder pair of walking-legs after they have been bored out by the jaws.

The crabs go to their original habitat, the sea, to lay their eggs, and the young are hatched and live for some time on the coast. The *Birgus* is very instructive, as it illustrates how a marine animal may become adapted to live on the land and breathe air instead of water. It appears to have accomplished this by changing a part of each gill-cavity into a lung.

According to Semper,* each gill-cavity consists of a lower and upper portion. The lower portion is the smaller, and contains the true gills, while the roof or dorsal part "is to be regarded with certainty as a "lung." In the crabs examined, the lateral cavities always contained air, and only sufficient water to keep the parts moist. This small amount of water is necessary, as it is a well-known fact that the breathing organs of all animals can only absorb oxygen in sufficient quantities when the surface membranes are kept moist.

The "lungs" are richly supplied with blood-vessels. The situation of these vessels, the direction of the flow of blood through them, and the fact that this blood cannot be regarded as

* Zeitschrift für Wissenschraft. Zoölogie, Vol. XXX. Translated in International Scientific Series, "Animal Life as affected by Natural Conditions," by Carl Semper, 1881.

arterial—all tend to prove that these crabs breathe by means of their lungs, and not by their gills.

"Should the gills in the gill-cavity of a land-crab," remarks Semper, "become yet more reduced, and at last entirely disappear, then would the simple gill-cavity be exactly equal, physiologically, to a true lung, as it is in the air-breathing snails, though it might still be called a gill-cavity, because it would be such morphologically."

The highest members of the *Anomoura* group, *Lithodes*, are so like some of the true crabs, especially the spider-crabs (Pl. VIII., Fig. 1), that they were formerly classified with these in the same family. They have the same form and general structure, but with only four pairs of functionally useful walking-legs, the fifth pair being very small, and the fifth ring to which these are attached being separated from the other thoracic rings, as in the hermit-crab. The abdomen is bent under the body as in the true crabs, and covered with soft skin on the inside, where it is protected, and with three rows of plates on the outside, where it is exposed, the terga in the centre, and the two rows of epimera on the sides.

Macroura.

This division, to which the lobster belongs, has already received its full share of attention, and need not be mentioned except so far as is necessary to show that its proper position in the classification is in close association with the highest group of the Crustacea, the *Brachyura*, common edible crabs, and the like. Pl. VI., Fig. 3, represents the Crayfish, *Astacus fluviatilis*.

Short Papers and Notes.

Resuscitation from Drowning.

SEA-BATHING is now so generally practised, and death by drowning so common, that every person should familiarise himself with some method of resuscitation; and if each community living upon the seashore or upon the banks of rivers or bays would organise a life-saving service, or obtain instructions in this important subject, many lives which are now sacrificed would undoubtedly be saved. One of the simplest methods of artificial respiration is that which Mr. J. A. Francis has described in the *British Medical Journal*. The body of the patient is laid on the back, with the clothes loosened,

and the mouth and nose wiped; two bystanders pass their right hands under the body at the level of the waist and grasp each other's hand; then raise the body until the tips of the fingers and the clothes of the subject alone touch the ground; count fifteen rapidly; then lower the body flat to the ground, and press the elbows to the sides hard; count fifteen again; then raise the body again for the same length of time, and so on, alternately raising and lowering. The head, arms, and legs are to be allowed to dangle down freely when the body is raised.

Method for Copying Drawings.

Rule across the drawing to be copied pencil-lines from right to left and from top to bottom at equal distances one from another; also rule your drawing-paper in the same manner, with the same number of lines in each. Number each square in the copy and its corresponding square on the drawing-paper with the same numbers. Now you will have a certain portion of the copy in each square, which may be copied in the usual manner into the corresponding square with much greater accuracy than without the use of the lines. It is very evident that the greater the number of squares, the easier will it be to copy; consequently, I would advise anyone whose sketching demands improvement to commence with as large a number of squares as possible and gradually to diminish the number, so that after a time he will be able to draw correctly without the use of the lines at all. If the pencil-lines would injure the copy, a frame could be constructed, which might be fastened and stretched across the copy.

V. A. Latham.

Management of Gold-Fish.

Gold-fish may be kept ten or twelve years (their average period of existence) by using the following precautions:—(1) Allow not more than one fish to two quarts of water. (2) Constantly use the same kind of water, whether well or river; change it every other day in summer, or twice a week in winter. (3) Keep clean sand and pebbles at the bottom, washing them occasionally or replacing with a fresh supply. (4) Use a small net to catch the fish when changing the water. (5) Feed with sliced meat, thread-worms, or flies, once each week, except in cold weather; feed but little at a time. Remove any uneaten food that may remain after feeding. (6) Do not feed at all from November to the end of February, and but little during the following three months. (7) If there are growing-plants in the aquarium, the water need be changed but very rarely. (8) Keep from the sun and in the coolest part of the room.

V. A. L.

Engraving on Copper.

A process of engraving on copper, with special reference to map-work, and which commends itself on account of its simplicity and economy of cost, consists essentially in first electro-plating or otherwise coating the object with a thin layer of silver, which is then evenly coated with a coloured varnish. The outline, topography, and lettering are then marked in with a dry point, as is done with a diamond in engraving upon stone. These lines are next etched by means of the perchloride of iron. The labour of transferring the drawing upon the plate may be greatly facilitated by the use of photography. It will be understood that the object of the silver coating is to secure a perfectly sharp and distinct outline after the etching has been accomplished. V. A. L.

Ancient Stature.

The French Orientalist, Henrion, member of the Academy, gives the following table of the relative heights of several eminent historical personages. It is interesting to have the height of Eve to the decimal of an inch:—

Adam was precisely	123 ft. 9 in.
Eve	118 ft. 9·75 in.
Noah	103 ft.
Abraham	27 ft.
Moses	13 ft.
Hercules	10 ft.
Alexander	6 ft.
Julius Cæsar	5 ft.

It must, however, be stated that the measure of the traditional tomb of Eve at Jedda gives her much greater stature. The French Consul in Abyssinia writes in 1841:—"On entering the great gate of the cemetery, one observes on the left a little wall three feet high, forming a square of ten or twelve feet. There lies the head of our first mother. In the middle of the cemetery is a sort of cupola, where resides the middle of her body, and at the other extremity, near the door of egress, is another little wall, also three feet high, forming a lozenge-shaped enclosure. There are her feet. In this place is a large piece of cloth, whereon the faithful deposit their offerings, which serve for the maintenance of a constant burning of perfumes over the midst of her body. The distance between her head and feet is four hundred feet. How we have shrunk since the creation!"

Microscopical Objects.

Beautiful microscopical objects for polarised light are produced

by the action of undiluted fluoric acid on an ordinary glass slide, the results varying with the composition of the glass acted upon. The best results are to be obtained by using slips of thin polished plate and the following process :—Cut a circular hole in a piece of sheet-modelling wax ; warm the slide slightly, and make the wax adhere well to it, so as to form a fluid-tight cell. Into this put four or five drops of the acid ; watch its action closely when the glass has acquired an opaque film, which will be in from three to five minutes ; wash it with a stream of warm water ; finish with a camel-hair pencil. Remove the wax and dry the slide. The result shows crystals of silicon fluoride, which require no mounting.—*Dental Record.*

A Simple and Speedy Way of Staining Animal and Vegetable Sections.

After having used this method for some time, I have ventured to describe it in the pages of this journal for the benefit of those readers who may not know it. It is not a new or original one, but having found it very useful to me, I describe it for the benefit of others ignorant of it. After cutting your sections, wash them well in water, and allow them to soak in it for awhile. Then transfer to a solution of anilin violet in commercial acetic acid, made as follows :—Anilin violet, 1 part ; acetic acid, 300 parts. Leave them till sufficiently stained, which may be determined by removing them from the solution to clean water. Return them if not stained enough. Mount after staining by transferring them to a clean glass slide, drawing off any excess of the fluid, and add a drop of a solution of *acetate of potash* of the following strength :—Acetate of potash, 1 oz. ; water, ½ oz. Cover and fasten it (the cover) with varnish permanently if wished. The advantages claimed by this method are simplicity and beauty of the results obtained. I have found it very good for showing the structure of cartilage.

V. A. Latham, F.M.S.

Boarded by Centipedes.

An account comes from New York of a strange adventure which happened recently on board of the schooner *Lucy T. Harvey*, which was sailing from Port Prince to Philadelphia. The schooner was manned by a crew of negroes. She had left Port Prince some days, when the captain and the crew were all surprised to see the deck invaded by hundreds of centipedes, insects whose bite is as dangerous as that of scorpions. They succeeded, however, in killing them all with boiling water. Some days later the steward ran from the hold with cries of terror, saying that it swarmed with centipedes and scorpions. Some of the crew pro-

vided with lanterns descended into the hold, and the creatures, frightened by the light, came on the deck by thousands. The sailors, again frightened, sought refuge on the masts, and the captain could not make them descend. For two days the centipedes swarmed on the deck, and not one of the sailors would take the risk of quitting his refuge. A Newfoundland dog, who was chained in front, having been bitten, died in a few seconds. The captain and the mate, who remained at their posts, tried to destroy the insects by placing here and there pans of burning sulphur; but they only killed a hundred, and there were still thousands. At last a tempest, which under other circumstances would have been thought a great nuisance, arose, and the sea swept the deck, and soon the centipedes, etc., which had not been carried off by the waves died of cold. The schooner had a cargo composed of wood for building, much of which was worm-eaten, and in the interior of which the centipedes had probably made their nests.

A Rare Irish Orchid.

Visitors to the south-west of Ireland on their way from Killarney to Cork by Glengariff pass along the upper or inland portion of Bantry Bay. Generally content with the beauties of the scenery surrounding them, they seldom explore the remote recesses of this magnificent arm of the Atlantic. Some 24 miles from Glengariff, on the northern side of the bay, lies the picturesque village of Castletown, protected from the south-westerly gales by a long chain of hills some 900 ft. high, detached from the main land, called Bear Island. In the channel known as Bear Haven our fleet often rides securely at anchor. Here, in a few sunny, sheltered spots, by the border of the sea, in little seaside meadows, there are now to be found in full flower specimens of a deliciously fragrant orchid—the sweet-scented Lady's Tresses. Each plant bears a stout spike of flowers of a cream-white colour arranged in three series or rows, each flower being at least three times as large as those of the autumnal Lady's Tresses so commonly to be met with in the dry pastures of the south of England and Ireland at this season. By botanists it is called *Spiranthes Romanzoviana.* Sir Joseph Hooker once referred it to *S. cernua*, a species common in the United States, and till quite recently confounded with it by the American botanists. The chief charm or attraction in this little orchid is, however, its very peculiar geographical distribution. Except over a few acres near Castletown looking towards the south-west, it is not to be met elsewhere in the Old World. Unlike some of the rarer West of Ireland plants, it does not occur on the west coasts of Spain or Portugal; and yet cross over the Atlantic and it is to be met with

in New York and thence on to the very borders of the Pacific. No doubt as to its being a true native of Ireland seems ever to have crossed the mind of any botanist; indeed, it is one of the most unlikely of plants to have been accidentally or otherwise transplanted, so that probably the solution of the question as to its origin on the shores of Bantry Bay must ever remain a mystery. The very remoteness of its *habitat* secures for it this advantage—that, while it will ever be a rare plant in our collections, it is not likely that it will ever be extirpated.

The Chestnut on Mount Etna.

One of the noblest trees on record is the chestnut upon Mount Etna, called the *Castagna de cento cavalli.* It is still alive, but has lost much of its original dignity. Many travellers take notice of it. Brydone was one of the last who saw it. His account is dated about sixteen or seventeen years ago. It had then the appearance of five distinct trees. The space within them, he was assured, had once been filled with solid timber, when the whole formed only one tree. The possibility of this he could not at first conceive, for the five trees together contained a space of two hundred and four feet in circumference. At length, however, he was convinced, not only by the testimony of the country, and the accurate examination of the Canon Recupero, a learned naturalist in those parts, but by the appearance of the trees themselves, none of which had any bark on the inside. This chestnut is of such renown, that Brydone tells us he had seen it marked in an old map of Sicily, published a hundred years ago.—*Gilpin's Forest Scenery.*

Reindeer Skin.

A Norwegian engineer, Herr W. C. Möller, has made some important discoveries as to the buoyancy of reindeer hair and skin. He has found that a reindeer skin weighing a 7/10 kilogrm., rolled up and with the hair outwards, will support for ten days the same weight as an ordinary cork life-belt. Moreover, the reindeer skin has the advantage of warming a person if formed in the shape of a life-belt and worn round the waist. He has also constructed collapsing boats, sledges for rescuing people from drowning in the ice, etc., from reindeer skin, and life-belts filled with reindeer hair equal to those of cork. Herr Möller further finds that a suit made from reindeer hair, weighing only ½ kilogrm., will save a man from drowning even if it has been in the water for some time. It can be made in any thickness, and is warmer than other materials. He is confident that suits made from reindeer hair will in time supercede those made from oil-skin. The life-saving establishment of Gothenberg has already procured several of these articles.

A Spider's Ready Wit.

Dr. J. Lawrence-Hamilton, of London, writes:—"The following incident, which I witnessed, may possibly interest some of your readers: A boy removed a small spider to place it in a big spider's web, which was hung among foliage, and distant some four feet from the ground. The larger animal soon rushed from its hiding-place under a leaf to attack the intruder, who ran up one of the ascending lines by which the web was secured. The big spider gained rapidly upon its desired prey, the smaller creature (spiders are cannibals, notably the larger females, who are given to devour their smaller male lovers). When the little spider was barely an inch in advance of its pursuer, it cut with one of its legs the line behind itself, so that the stronger insect fell to the ground, thus affording time and opportunity for the diminutive spider to escape along the ascending rope of the web. This is not the only fact which seems to indicate that a spider's instinct may almost equal reason."

Answers to Queries.

181.—Plant-Crystals.—Mr. Hammond, in *Science Gossip*, p. 130, 1878, gives a detailed account of the process. Before mounting in the medium, he soaks leaves or sections for two days in rectified spirit, $1\frac{1}{2}$ oz.; pure water, $1\frac{1}{2}$ oz.; pure glycerine, 5 drams. He also uses dammar or balsam. I have a section of leaf of *Mercurialis perennis*, which shows the crystals well mounted in Canada balsam. V. A. L.

208.—Suint.—The fatty secretion from the skin of the sheep, which is always associated with the wool. It consists largely of various soluble salts of potassium. For more details and chemical extractions, as cholesterin, stearerin, elairerin, see Dr. Bowin on "Structure of the Wool Fibre," p. 180. W. L. W. E.

208.—Suint.—Suint is a kind of soap [it is the perspiration of sheep condensed on their wool], consisting of potash in combination with a number of fatty, and the following non-fatty, acids:—Sulphuric (H_2SO_4), Silicic (H_4SiO_4), Phosphoric (H_3PO_4), Carbonic (H_2CO_3), and Oxalic ($H_2C_2O_4$). (See *Chemical News*, Vol. XIII,, p. 237, 1866.) F. W. Steel.

208.—Suint.—Suint is an organic compound of potassium existing largely in the fleece of the sheep from which it may readily be extracted by cold water. On incineration, it yields carbonate of potassium, and were the English butchers and wool-

dressers to utilise it, as they could easily do, it would be a very valuable source of income to anyone dealing largely in unwashed wool. J. W. G.

209.—Occidental Bezoar.—The following extract may be of service :—"In 1829, Dr. Buckland drew attention to the discovery of coprolites in the lias at Lyme Regis. These had been called 'Bezoar Stones' from their external resemblance to the concretions in the gall bladder of the Bezoar Goat, once so celebrated in medicine." See "The Geology of England and Wales," Horace B. Woodward, 2nd edition, p. 263. W. L. W. E.

209.—Peculiar Mineral.—The bezoar is a concretion found in the stomachs of goats or antelopes, and formerly much valued as an antidote to poisons. The value of a bezoar being supposed to increase with its size, the larger ones have been sold in India for very great prices. J. W. G.

210.—Histo-Pathological Work.—For this work I do not like a *very wide* angle; still, one wants a good field and very good definition over the whole field. The *very-wide* angle lenses give splendid definitions in one particular plane, but for histo-pathological work you require more than this, and without actually losing definition you require to see the rounded contour of objects. For bacteria, get a 1/16th or 1/20th of the widest possible angle; for general work, a good ⅙th and 1/9th are amply sufficient. J. W. G.

214.—Rectified Spirit.—Methylated spirit, NOT methylated FINISH, answers perfectly. It should not be diluted, otherwise maceration is likely to occur in time. It ought not to be less than 56 above proof and is better at 60. J. W. G.

216.—Orange Insects.—It may interest "Alcedo" to know that on March 13th, 1861, the late Mr. Richard Beck read a paper before the Microscopical Society of London on "The Metamorphoses of a Coccus found upon Oranges," which paper, with a plate, was published in the Transactions of the Society for that year, to which I would refer him. T. SYMPSON.

221.—Landscape Photography.—The chief reason why many persons prefer slow- to quick-plates for landscape photography is not on account of any finer deposit in the one case more than the other, but because with quick-plates the risk of failure is so much greater. If you have a plate that with a given aperture produces a perfect impression in five seconds, there will be very little difference if you have only given it four seconds or have given it as much as six seconds; but if you have a plate that requires but the 1/20th of a second, it will most likely be spoiled if it has been exposed a 1/5 or a ½ second. W. P.

230.—Atlantic Ooze.—The following is the process given by Davis in his "Preparation and Mounting of Microscopic Objects," a work which this querist would do well to obtain:—"If the specimens are in mud, we must proceed in a different way. Stir up the whole mass in water, and allow to stand until the heavier portion has sunk to the bottom; the water may then be poured off and examined to see if there are any objects contained in it. This process must be repeated until the water comes off quite clear, when (if the search is for foraminifera only) the solution of caustic potash may be used as before mentioned." Referring back, I find, "To clean the foraminifera, Professor Williamson advises the transfer of the specimens to an evaporating dish containing a weak solution of caustic potash. This must be boiled for some moments, when the organic matter will be entirely dissolved, and the calcareous shells left free from impurity. They must now be well washed in water, so that all alkaline matter may be entirely removed." I would advise the gentleman owning the Atlantic ooze to get this valuable book, and read up all the methods of cleaning foraminifera given, and he will be able to choose the one which seems most suitable to him. A. D.

231.—Micro-Photographs.—I am afraid these will be found almost impossible to remove, as they are probably on a collodion film. The following plan might be tried:—Cover with a fresh drop of collodion (if varnished first, remove it by alcohol), then soak in a *weak solution* of acid and water. Hydrofluoric acid is said to be the best. The photograph will probably float off, and must then be remounted on a slip of glass and well washed. It will probably adhere of its own accord, and a thin varnish or a cover-glass will secure it. Micro-photographs are said to be easily made, using the microscope as a camera, but I have never tried. J. G. P. Vereker.

233.—Double Nose-Pieces.—These are, I believe, best avoided, though very seductive to read about in the catalogues. The weight of those adapted to carry the English objectives must throw a strain upon the delicate adjustments of the microscope, though this is probably inappreciable with the lighter forms used on instruments like Zeiss' travelling microscope, but they still have the disadvantage of exposing the spare objective to accidental injury. There is, however, a form of nose-piece which enables objectives to be changed very rapidly made by "Pease," and sold by Coppock, Bond Street, London; price, I think, 25s., which, though a trifle heavy, is free from the leverage strain, and also from the chance of accidental damage to the spare objectives. It works on the principle of the self-centering clinch of a lathe, and the objectives are changed by a quarter turn of the ring on it.

J. G. P. Vereker.

236.—Preparing and Mounting Zoophytes.—These, when dried, show no tentacles, and, therefore, this questioner is likely to experience more than "great difficulty in spreading out the tentacles so as to show their structure." The *tentacles* form part of the living animal, and are destroyed along with it in drying, so that we need only consider the polypidom at present. To hit upon the right method in ach individual case requires experience. If it is so thick that balsam would not make it transparent, it must be mounted dry in a cell. Most, however, may be mounted in balsam and used with the polariscope. To get rid of the air-bubbles, which will permeate the whole structure of these organisms, is the first object. To do this, I think, the best plan is to boil in methylated sulphuric ether, sometimes four or five times if the air is refractory, allowing the test-tube to cool between each boiling. Then transfer to absolute alcohol for ten minutes, then to oil of cloves or cajeput for five or ten minutes, after which mount in balsam in the usual way. The mounting dry requires no directions. Some species may with advantage be mounted both in Canada balsam and dry. A. D.

236.—Preparing Zoophytes.—Wash the specimen well in clean water to get rid of all sand, etc.; then place a sheet of paper under them (floating), and lift out of water. Arrange the tentacles as desired; then take a small piece, and dry and mount. Soak in alcohol to get rid of water or benzole, and mount in Canada balsam. In some specimens the larger and darker species mount in balsam, though they make very pretty objects dry on a black ground. See Mr. Pennington's "British Zoophytes."

V. A. L.

237.—Grubs in Helix Caperata.—These may be the larvæ of the glow-worm (*Lampyris noctiluca*) or of an allied insect known as *Drilus flavescens*. Both these beetles belong to the family of the *Lampyridæ*, one of the fifteen into which the *Malacodermi* are divided. The larvæ of both these beetles feed upon living snails.

A. D.

238.—Mounting without Pressure.—As I have mounted some scores of objects—chiefly entomological—in balsam without pressure, in the manner A. B. refers to, and as those of my friends interested in mounting who have seen them have been pleased to admire them, I have pleasure in giving the simple practical information necessary to put our friend in the way of so mounting for himself. I procured at a needlework shop an oz. each of glass beads of the *smallest* and next two larger sizes. These I keep carefully apart in strong pill-boxes. The three sizes are not, unfor-

tunately, absolutely uniform in size amongst themselves, but this only involves a little care in selecting the set of three required for each mount in this way:—Three beads (or, to save time, I generally take a half-dozen or so) are put on the slip, looking as nearly the same size as possible. Place them equi-distant, triangularly, and place on them the cover selected, carefully raise the whole to the level of the eyes, when, *if they are in contact* (*i.e.*, the three beads and the cover), put them aside for the mount; if not, proceed with the selection until you have three that are near enough. Of course, whether the smallest or either of the other sizes is the most desirable is determined by the thickness (depth) of the object for which the cell is required. This, a little practice, accompanied by a few failures, will enable the operator to quickly determine. And while on the subject of depth of cell, I may add that, in my experience, *every* (balsam-mounted) object that has *any appreciable thickness* is much more easily and perfectly manipulated when the cover is kept at a fixed distance from the slip, and I, therefore, keep a series of cards (visiting, trade, and show-cards), from which I snip three tiny bits when I find my beads too thick, or when I want to make a cell of a depth *between* either of the three formed by the beads.

We now come to the "fastening-on." I at first attached the beads (or cards) to the slip itself, but quickly found it vastly better to fix them to the cover thus:—Dip a fine needle into Canada balsam (diluted with chemically-pure benzole) sufficiently limpid to *run freely*, and only *just dip* the needle so as to have attached to the point a mere speck of the fluid. Have your cover perfectly clean on the mounting table (I use a slab of plate glass), and with the needle-point place three spots from it on the cover, equi-distant and as near the margin as possible; with the fine forceps place a bead on each spot, slightly pressing it into the spot of balsam. Of course, this side of the cover must be scrupulously clean and kept so, as it becomes the roof of the cell, and cannot well be cleaned after the beads are on. Now transfer the beaded cover to a watch-glass, and cover it with another to keep dust from it while the object is being centred and laid out on the slip. I must here digress slightly, as, at this stage, a difference in the final stage in the *preparation of the object* may interfere with the result. My objects (entomological) are all placed, finally (before mounting), in chemically-pure benzole, and where there is benzole there can be no air-bubbles. Should A. B. be in the habit of pressing flat, drying, and soaking in turpentine—the old plan—let him, to follow out my instructions, which will then not admit of failure, transfer his object for a few minutes (or seconds, if very small) to benzole, and I am sure he will be

pleased with the result. Now, having centred the perfectly clean slip, transfer the object from the benzole to the true centre of the slip, and, lest the benzole should have partially or wholly evaporated, drop a little on it (from time to time if the laying out properly takes any time), so that when we come to placing the cover, the object may be just covered with the liquid. Benzole and balsam, I need scarcely mention, are perfectly miscible, the former being a solvent of the latter, and in availing myself of this fact lies my absolute freedom from air-bubbles. Having the object centred, properly displayed, and immersed in benzole on the slip, now take the cover by the forceps from the watch-glass, and place it, truly central, over the object on the slip. When so placed, I like the cover to *just touch* the object, and *only touch*, and this, in five mounts out of six, I contrive. It is not, however, absolutely necessary. Having the cover satisfactorily placed, the object will be found in a little pool of benzole. And now a spring clip must be applied to keep the cover in position, while the *limpid* benzo-balsam is run in.

While in this stage (*i.e.*, with the object in position, immersed in benzole, and cover, slide, and the whole affair gripped by the clip), I put it under the compound microscope to see that all is right, because at this stage, if anything is seriously wrong, the whole thing can be instantly dismantled and the object put back into benzole. Presuming, however, that all is right, I now, with the clipped slide in my left hand, but held as closely as possible to the mouth of my benzo-balsam bottle, dip a *coarse* dissecting needle into the latter deep enough to collect two or three "drops" of the fluid. This I quickly, but coolly (coolness is a valuable quality in micro. work) transfer to the edge of the cover, when, by capillary attraction, it instantly travels to the object without in the least disturbing it, *because*, when it arrives, it finds benzole *in possession*, and its first business is to mingle with that, not displace it. These dips are, of course, repeated until the space between the slip and cover is filled with the medium. There is no fear of the balsam running over the slide. To satisfy myself, I have this moment placed a ¾-inch cover on a set of my second-size beads on a slip, making a deepish cell, and have run *water* in, and the liquid is rigidly confined to the covered area. This finishes the operation. Except that the balsam will shortly be found to shrink away from the margin of the cover owing to the evaporation of the benzole contained in the balsam, and this must of course be replaced with balsam, so that the cell may, to facilitate finishing, ringing, etc., be, when quite dry and hard, a solid circular slab of balsam. While writing this, I have gone mentally through the whole operation, and do not think I have

omitted anything necessary. I will only add that the process is easily mastered, and that I shall be happy to furnish any further information if any point is not quite clear. F. R. BROKENSHIRE.

242—Cement for Glycerine Mounts.—It seems needless to recommend gold-size, but it is most useful. I have found a rather thin solution of Canada balsam in benzole answer exceedingly well. A. W. L.

244.—Mosses, Mounted Slides.—As for mounting, a concentrated solution of acetate of potash seems to keep the chlorophyll in a very natural condition. A. W. L.

247.—Salivary Glands of Cockroach.—This is a most interesting and instructive slide, and well repays the little amount of trouble that may be expended in its preparation. The cockroach is killed by immersion in methylated spirit. It is then pinned down under water in a dissecting trough, the pins being passed through the coxæ of the first and last pair of legs, and a fifth, slanting well back so that its head may be out of the way, is driven through the last segment. The wings, etc., having been removed, two longitudinal incisions are made on the dorsal surface in the following manner:—The last but one dorsal plate is gently raised by means of forceps and one blade of a pair of fine dissecting scissors carefully inserted underneath it well to the side. The plate is now snipped through, and so on with the other ones as far as and including the pronotum, or first dorsal tergum. A similar incision must be carried up the other side of the back. Then each tergum is removed separately, working from behind forwards by gently raising it and scratching away any connections between it and the underlying soft parts, at the same time exerting GENTLE friction in an upward and backward direction—*i.e.*, towards the dissector. The tergum will be found to come away quite easily. Repeat this operation till all the plates have been taken away, being careful not to injure the abdominal viscera. The most conspicuous object in this stage of the dissection will be the large, somewhat pear-shaped crop, which in all probability will be well dilated. This narrows off anteriorly into the œsophagus. Now, on either side of the anterior half, or so, of the crop will be seen portions more opaque than the rest, and therefore whiter. These, on closer examination, will be found to be the salivary glands. The simplest way of dissecting them out is to gently raise the crop in the forceps (the glands being firmly adherent to the lateral walls), and follows up the œsophagus to the mouth, carefully snipping through any of the dorsal wall, including that of the head, which may interfere with the freeing of the tube until the mouth is reached. Then, having quite separated out the œsophagus, it is

cut across as far forwards as may be so as to include a portion of the lingua. The crop and œsophagus are now transferred to clean water; the salivary glands, ducts, and receptacles carefully isolated from the crop, etc., with needles. When this has been effected, the glands, etc., are ready for staining. I prefer Beale's carmine solution, followed by the acid glycerine. This removes the stain from all parts but the nuclei. The whole thing is now carefully placed upon a slide and arranged by means of needles, and sufficient glycerine having been added, a cover-glass is applied and the slide cemented with gold-size. It is thus quite possible to arrange the whole salivary apparatus, glands, sacs, and ducts on one slide. I have not given a description of the staining process, as the method of using Beale's carmine fluid is probably known to every worker with the microscope. A. W. L.

Queries.

All Questions and Answers should be clearly and concisely written on one side of the paper only, and every question or answer must bear the name and address of the writer. If this is written on the left-hand bottom corner, it will not be published, in which case initials or other signature should appear in the usual place. When more than one answer is sent by the same correspondent, each must be written on a separate piece of paper.

Correspondents, in sending us answers to questions, are desired to commence by quoting the number and title of the question as printed, before beginning their replies.

270.—Thawing Green Vegetables.—When green vegetables, such as cabbages, are required for use in frosty weather, they should be thawed in cold water; if hot water is used, they become disagreeable and even poisonous when cooked. Can any reader explain the cause of this, and what chemical change takes place when they are thawed in hot water? J. B.

271.—Preservation of Flowers.—How can I preserve some specimens of flowers to use in teaching botany during the winter? I would like to keep them in their natural form, not pressed. J. B.

272.—Micro-Fungi.—Would someone kindly give full directions for the mounting of fungi from the first step? what parts to use, and how to obtain only a small quantity, so as to show to best advantage? Asaph.

273.—Water-glass Cement.—Can any reader inform me of what water-glass consists, and where it may be obtained? It is very good for mending broken china and glass. V. A. L.

274.—Paraffin and Ether (Marsh, "Section-Cutting" (82), p. 68).—He recommends that "Sections, when cut, are to be soaked

in alcohol." Can anyone explain *why?* and why should ether in this case be used instead of chloroform? Has it any special advantage? ENQUIRER.

275.—Klein's Dammar.—Will any reader kindly give me the formula for *Klein's* Dammar and the particular advantages of the same? A. V.

Sale and Exchange Column.

[All Exchange Notices are inserted free; for Notices of Books or Scientific Instruments or Accessories offered for sale, a charge of 4d. for the first 12 words and 1d. for every succeeding 3 words will be made.]

Beale's "How to Work with the Microscope," 4th ed., Lankester's "Half-Hours with the Microscope," Suffolk's "Microscopic Manipulation," and Phin's "How to use the Microscope," in exchange for "American Monthly" and other journals, bound.—J. Elliott, Aberystwith.

Powell and Leland's 1—12th imm., 1·26 N.A., new, to exchange for the same maker's 1—6th ditto ditto.—J. Elliott, Aberystwith.

In exchange for a few drops of material containing *large* Diatoms, I will send, when mounted, a Selected Slide of Species contained therein. The sand generally washed away in cleaning marine deposits often contains good forms for selecting, and will be gladly received.—G. H. Bryan, Thornlea, Cambridge.

Wanted, Darwin's Naturalist's Voyage or Bates's Naturalist on the Amazon. Will give for either Scott's Meteorology (5s.) and Harriet Power's Manual for the Physiological Laboratory (5s.). or 10 parts (1s. 6d. part) Proceedings Royal Geographical Society (maps), 1880—1, and 4 Nos. *Journal of Microscopy and Natural Science* (April, 1885, to Jan., 1886).—H. Hiller, 82 Pinstone Street, Sheffield.

Three gross Micro Slides at 6s. per dozen. Money returned, less postage, if unsatisfactory. Sample slide, post free, 8d. State class of object required.—Downes, 5 Royal Park Road, Bristol.

Kirby's "European Butterflies and Moths," new, bound, approval, 25s.—A. Downes, Bristol.

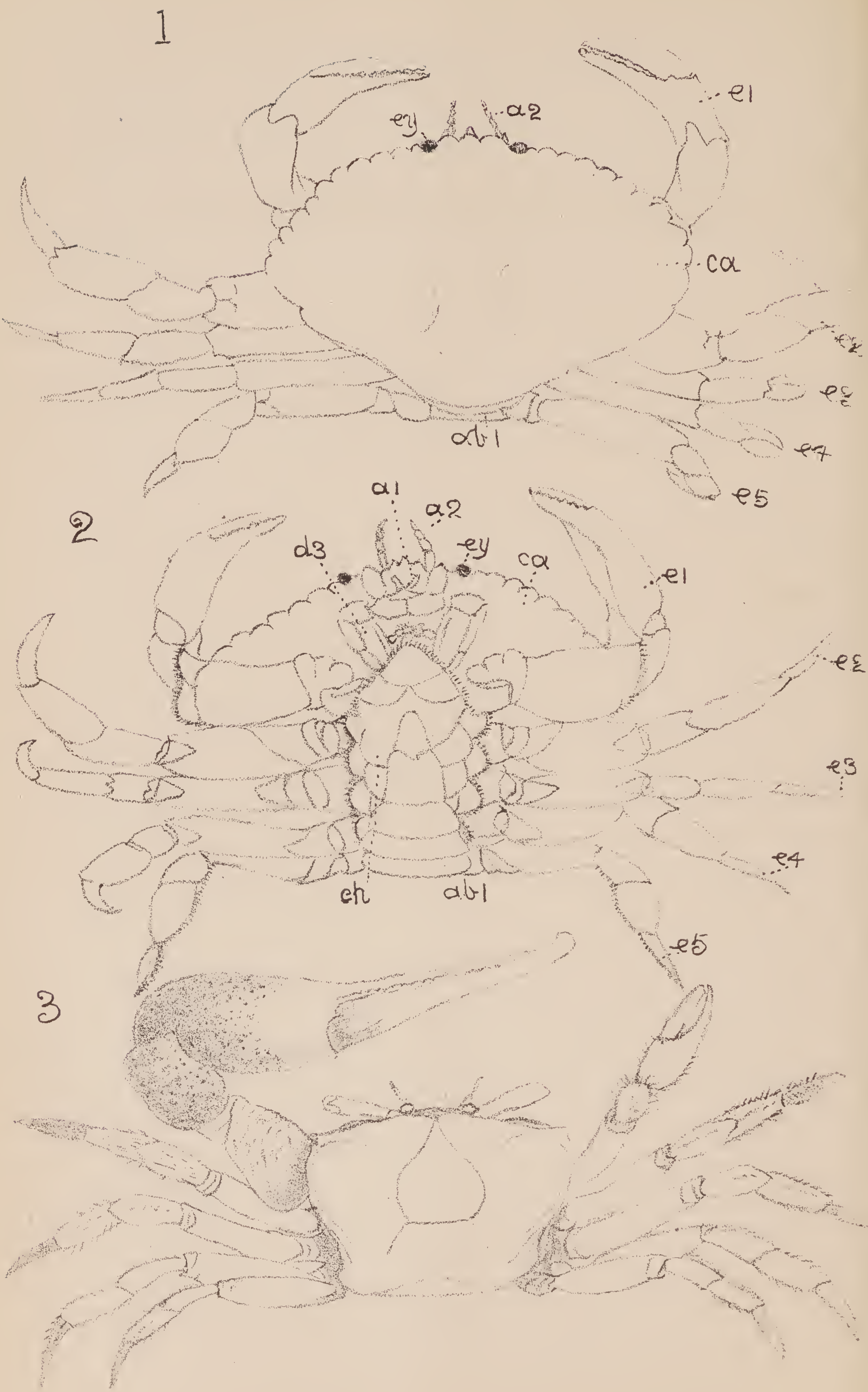
Good, named, Mounted and Unmounted Microscopic Objects in exchange for named Cabinet Specimens of Diptera, Hymenoptera, and Hemiptera not in collection.—Chas. J. Watkins, King's Mill House, Painswick, Glo'stershire

Microscopical Slips, Thin Covers, Media, Cements, etc., 33 kinds of Labels; samples, 2d. *Unmounted Objects* as fine Polariscopic Horn and Hoof Sections, Insects, Zoophytes, brilliant selected Show Objects from Exotic Lepidoptera, etc.—Chas. Watkins, King's Mill House, Painswick, Gloucestershire.

Natural History and Musical Works, Oolitic Fossil Coral, Micro Preparations, in exchange for named cabinet specimens of Diptera and Hymenoptera not in collection.—Chas. Watkins, Painswick, Gloucestershire.

Worked Flints, Paleolithic and Neolithic, in exchange for Fossils.—Apply to J. French, Felstead, Essex.

High-class Injections from Monkey, consisting of lip, tongue, liver, lung, spleen, finger. The six slides for 5s.—Henry Vial, Crediton, Devon.



Crustacea

The Scientific Enquirer.

AUGUST, 1887.

Crustacea.

BY ALPHEUS HYATT.

CHAPTER VI. PLATE VII.

Brachyura.

WE now pass to the crabs proper, or to the highest of Crustacea. Pl. VI., Fig. 4, and Pl. VII., Figs. 1 and 2, represent our commonest species of the genus *Cancer*. The abdomen, of the crab, the first ring of which is seen from above (Pl. VII., Fig. 1, *ab* 1) and all the rings from below (Pl. VII., Fig. 2, *ab* 1—5), is reduced to a mere flap turned under the cephalothorax, while its appendages in the female (Pl. VI., Fig. 4) are reduced in size and covered up between the thorax and abdomen, and are used only for holding the eggs (*eg*.).

The abdomen of the male is smaller, more pointed, and the anterior appendages are not so well developed. The cephalothorax (Pl. VII., Figs. 1 and 2, *cth*) is broader than that of the lobster, but its appendages are equal in number, consisting of five pairs of walking-legs (Pl. VII., Figs. 1 and 2, *e* 1-*e* 5), six pairs of mouth parts, two pairs of antennæ (Fig. 2, *a* 1, *a* 2), and a pair of eye-stalks (*ey*). We cannot fail to observe, however, that these appendages are crowded more closely together than those of the other Crustacea we have already studied. If we dissect the crab, we find a great concentration of the internal organs, especially of the nervous system. Instead of many ganglia scattered along a nerve-cord, all the ganglia behind the mouth in the crab have coalesced to form a single mass. Thus it is seen that not only are the two regions of the body concentrated in the crab as in the lobster, but the third or abdominal region is doubled up under the cephalothorax, so that, when looked at from above, the crab appears to be merely a perambulatory cephalic shield.

The crab moves sidewise, and when cornered faces the enemy with its two arms thrown up, and ready for action. The jaws are used, not only for capturing, killing, and crushing the prey, but

also perform the additional labour of holding it up to the mandibles and helping them to tear off pieces of suitable size for chewing, thus taking the work done in the lobster by both the arms and the third pair of maxillipeds. They are, therefore, not twisted so much as in the lobster, but work vertically, and the arms are not too long, being able to reach the mouth by a sharp bend. The legs of one side are used to push with, and those of the other to pull with, when the crab is in motion. Those of the same side do not, however, all move together, but alternately, so that there is no halting in their gait ; some of the legs are always in the act of taking new steps, and by shoving and pulling in unison a continuous motion is kept up. This crawling by means of jointed appendages can be imitated after having once seen a live crab. Cross the two wrists side by side, placing the fingers down on a level table; bind the wrists by an elastic band, hold them well up from the table, so as to show the fingers. Then let one set crawl while the other pushes, so as to keep up a continuous motion sidewise without assistance from the arms. The terminal sections of the legs show wear only on the points where these are inserted in the ground.

Some of the Brachyura not only walk, but also swim rapidly sidewise with oar-like paddles, which are developed from the fifth pair of walking-legs. The blue crab of southern New England, *Callinectes hastatus*, is a common type of this group.

The Fiddler crab (Pl. VII., Fig. 3) is smaller than the common crab, though like it in important structural characters. One of the arms of the male is very much larger than the other, giving a peculiar appearance to the animal, which is supposed to remind one of a violin. The large arm is used in fighting, which accounts for its size and strength. The females have little inclination to battle, and both arms are small. Thus, though the two arms are naturally, or, as we might more strictly say, normally equal, one becomes larger by the more active use it is put to by the male, for the same reason that our right arm becomes larger than our left. Occasionally, crabs are found which are left-armed, just as our children are sometimes left-handed.*

* If teachers and parents could but see the true meaning of such facts, and apply them, they would abandon the practice of confirming children in the habit of making themselves one-sided, and would encourage them to use both hands. One of these days this custom of teaching children to use the right arm and right side, to the injurious exclusion of the left, will be looked upon as one of the numerous indications of the unenlightened condition of the human mind at the present time. Other indications, such as the barbarous habit of piercing the ears, and the unhealthy practices of wearing corsets and tight boots, are in opposition to the teachings of physiology as well as those of good taste, and can only be accounted for by the prevailing blindness to their real ugliness and ignorance of the extent of the injuries caused by their use.

The Spider crab is a curious form (Pl. VIII., Fig. 1), which inhabits the shallow waters along the coast, and is frequently found covered with algæ, barnacles, or even oyster-shells, showing that it does not shed its shell as often as the lobster or most of the Brachyura. The form is intermediate, in respect to the shape of the carapace, between the Macroura and the higher Brachyura, and this coincides also with its sluggish style of walking, long, weak appendages, and generally immature characteristics as compared with those of the more perfect walking forms of the latter.

That curious little parasite, the Oyster crab, *Pinnotheres ostreum* (after Morse, Pl. VIII., Fig. 2, female), also belongs among the Brachyura, but can be more appropriately described further on.

In the Brachyura we get the highest expression of the concentration of the regions, and not only this, but a still more remarkable change, since the cephalothorax tends to become broader from side to side. The general concentration seems to be well accounted for by the change of function from a swimming to a walking type, but how shall we account for this lateral spreading? The animal, having a narrow body, could not move with as great rapidity as if it used the legs of one side in pushing and those of the other in pulling the body simultaneously. Any effort to do this would certainly cause a great increase in lateral development, and materially alter the form, so that in its progress sidewise it would offer as little resistance to the surrounding medium as the elongated bodies of animals which habitually move forwards. In other words, the reason why the crab crawls sidewise is, that it is the direction in which its type can move with the greatest readiness and acquire the greatest strength of limb and the maximum of speed.

The history of the development of the Crustacea, in spite of its peculiar interest, must be omitted for want of space. Information on the subject may be obtained from Packard's "Zoölogy," or from almost any of the manuals.*

We have described the Isopods, Amphipods, and a typical form of the Anomoura, Macroura, and Brachyura, but there still remain unnoticed several very remarkable orders, of which mention is made in all the text-books. To the lowest order, Cirripedia, belong the barnacles (Pl. VIII., Fig. 8, *Balanus balanoides;* Pl. IX., Fig. 1, *Balanus tintinnabulum*, and Fig. 2, *Balanus Hameri*), which whiten our rocky shores, and the piles of our wharves

* See also "On the Development of Decapod Crustacea." Spence Bate. "Early Stages of the American Lobster." Smith. Trans. Conn. Acad., Vol. II. "Development of Squilla." Brooks. Biological Studies. 1878. Woodward's article on "Crustacea," in the *new* edition of the "Encyclopædia Britannica."

and bridges between tide-marks, with their innumerable shells. Though formerly classed with the Mollusca, these animals are true Crustacea. Attention is called to them here because they are familiar, and also because they are good illustrations of what is known as retrograde development. The young barnacles are free-swimming (Pl. VIII., Fig. 8, *a*), but after a time they cement their forward ends to the rocks by a sticky secretion which flows from the antennæ. The outer skin becomes calcified, and forms a conical shell of several pieces (Pl. IX., Figs. 1 and 2, *v*). In the top of the shell there are two valves, which, in the living animal, open and close. When open, six pairs of many-jointed appendages (Pl. IX., Fig. 1, *e* 1—*e* 6) are thrust out. These are beset with hairs, and sweeping through the water, they catch the food upon which these creatures feed, and carry it to the mouth. Groups of living barnacles may be obtained from the bottoms of vessels, or from piles or rocks, and when placed in sufficiently shallow water may be seen to use their legs in feeding. The articulated or Crustacean character of these appendages can be readily seen in all but the smallest species.

As Huxley says, the barnacle is an animal turned upside down, and kicking the food into its mouth with its legs. To us, however, it is an important illustration of the way in which a Crustacean may become adapted to lead a sedentary life, and to get its food by fishing in the waters, though wholly unable to walk. It must be remarked also how this capacity of a locomotive organism to change has enabled it to occupy places where, but for this capacity, it could not have existed. Thus it can live successfully upon the rocks, and anchor itself securely where the surf would sweep away or destroy the typical forms of the same class. It will be seen, moreover, that the barnacle accomplishes this by changing during its growth from the common Nauplius, or typical Crustacean, to a form which is difficult to recognise as belonging to the same class.

Short Papers and Notes.

On the Washing and Cleansing of Diatomaceous Deposits.

By E. S. Courroux.

THE complete cleansing of diatoms from foreign matter always presents a certain amount of trouble to the operator, but not more frequently than when the diatoms are sparingly distributed in mud. The diatoms

must obviously be separated both from matters of greater and of less weight than themselves. The crude method of getting rid of the former, by simply shaking up the mass in water and allowing the sand and heavy portions of the deposit to subside, will be observed generally to result in the loss of the larger diatoms, which sink with the sand and are thrown away; but the process of shaking the material containing the diatoms in water, and after their subsidence pouring off the supernatant fluid, may often be practised with success, in order to clear them from particles of lighter weight than themselves. The method, often advised, of whirling the deposit in a watch-glass or evaporating dish, will be found by experience to be the best for eliminating sand, but in order to obtain success by this method, the dish should be from four to eight inches in diameter, as the sand clings more readily to a larger surface.

Assuming, then, that the mud has undergone part of the cleansing process—*i.e.*, been boiled in acids, so that the valves of the diatoms individually are clean, and it remains to separate them from the other constituents of the mud—we shall require one or two glass evaporating dishes, of about six inches in diameter, one or two of a smaller size and a watch-glass or two, a few small beakers, and one or two plates of glass, measuring about three inches by four inches. These latter are of a more convenient size for our purpose than the ordinary three-inch by one-inch slides. The water containing the deposit should be poured into the large dish and allowed to rest for a few seconds, that the heavier particles in suspension may subside. The supernatant fluid is then gently poured off and kept for further examination. The deposit left behind in the large dish will consist of the larger diatoms mixed with sand and other foreign matter. If a little water is now poured into the dish and whirled round, the diatoms and other lighter substances will rise in the fluid and the sand will collect in the centre of the dish. The water, with the diatoms, etc., in suspension, should be quickly tipped out into a beaker, when the sand will be seen to remain behind. There may, perhaps, be a few diatoms left among the sand, or some of the sand may have followed the diatoms, but one or two repetitions of the process will eventually extract the diatoms.

In order to avoid the loss of the larger forms, the sand finally left behind should be spread in a drop of water a little at a time on one of the glass plates, and examined under the microscope, the instrument being placed in a perpendicular position. If there are still diatoms among the sand, the plate should be very slightly tilted cornerwise, when the diatoms will flow down to the lower corner, and may be dropped into a watch-glass, whilst the sand is

left behind on the plate. When the fluid containing the diatoms is thus fairly freed from sand, or at any rate the larger particles of sand, it should be poured into a small beaker to the depth of about $1\frac{1}{2}$ inches. The beaker must then be held against the palm of the hand, and violently shaken for a minute or two. It is then allowed to stand quietly for half-an-hour or longer for every inch in depth of the fluid in the beaker. The fluid is then gently poured off, and, as it will probably contain only fine particles of mud, may be thrown away. The process must be repeated until the deposit is entirely freed from mud. This washing is very important, and must be performed with patience, as it will sometimes take several days to thoroughly get rid of the mud. If the gathering is very muddy, the fluid first poured off may be quite opaque, but the process must be patiently repeated until the water poured off is quite clear. The length of time during which the fluid should stand varies, of course, in each case, and must be found by experience, but great care should be exercised when the diatoms are light, in case some should be washed away.

The washing may be performed in any bottle or test-tube, if preferred, and the settlement of the diatoms may with advantage be allowed to take place in an evaporating dish, as, owing to its shallowness, time will thereby be saved. The addition of a little *liquor ammoniæ* to the washing water will sometimes assist the process. When the deposit is quite clean, it will be found to consist of only very fine sand and diatoms. The former may be eliminated by again whirling in an evaporating dish, and for this purpose, as before observed, a dish of some size—*i.e.*, six inches in diameter—should be employed, as the finest sand seems to cling to it more readily than to one of a smaller surface. A smaller dish, or even a watch-glass, may be used when the sand to be got rid of is coarse, and the further use of a glass plate, as before described, for the purpose of freeing the diatoms from sand, is often attended with advantage. By a careful practice of these methods, the diatoms may be effectually cleansed from foreign material. The fluid which was at first poured off from the first dish and saved may be treated in a similar manner, and will probably be found to contain diatoms of less weight and smaller size. The process may thus be carried on until all the diatoms of the gathering have been obtained in a pure state. Some of the heavier diatoms may be difficult to separate from the sand, and may require to be picked out with a bristle. Sometimes the diatoms will adhere to the saucer with some tenacity, but a careful consideration of cause and effect, and also of the condition of the deposit in the process, will enable the operator to entirely separate the diatoms. The method here advocated has been found to succeed with very

muddy gatherings, but of course with cleaner gatherings the process has been much more easy. The operator may not always meet with success, nor find the above statements rigidly true for all cases; but if he performs the washing with patience, and exercises thought and attention in carrying on the work, he will very seldom fail to obtain his slides of diatoms entirely clean from foreign substances.

The Living Earth.

In a paper published in the *Indian Engineer*, an illustration is given of the life that dwells in nature, the phenomenon of earthquakes being cited. The peculiar terror of an earthquake lies mainly in the suddenness of its approach. Volcanic eruptions are usually preceded by vast rumblings, or jets of steam, or other unmistakeable tokens. Hurricanes and cyclones, in like manner, have heralds that announce their coming. But with an earthquake there are no premonitory symptoms. The great earthquake which took place at Lisbon in 1755 found the people engaged in their ordinary occupations. All the shocks were over in about five minutes. The first shock lasted about six seconds. In that brief space of time most of the houses had been thrown down, and thousands of men, women, and children crushed beneath the ruins. At times the ocean lends terrors to the scene. Thus, at Lisbon, a wave of water, over 50 feet high, rushed in among the houses and covered what still remained. In the Island of Jamaica, on a similar occasion, two thousand five hundred houses were buried in three minutes under thirty feet of water. Recent delicate scientific experiments have disclosed the fact that the surface of the land is never absolutely at rest for more than thirty hours at a time. Thus those great earthquakes which make epochs in history are merely extreme cases of forces that seldom sleep.—*Scientific American.*

To Quench Thirst.

A physician states that ice-water does not quench thirst, but increases it. "I remember a little story," he says, "which I think might do much good if published this hot weather, that I heard from an old sailor. He said that he and six shipwrecked companions lived four days on three pints of water, and were not a bit thirsty. When I asked him to explain, he said that instead of gulping the water down they each took a teaspoonful and gurgled it well in their mouths. If anyone will try the experiment, no matter how thirsty he is, by thoroughly rinsing the mouth with not over a tablespoonful of water, he will find it will quench his

thirst as effectually as a quart hastily swallowed, and will not hurt him. I believe that fully one-third of the deaths during the heated season are, if the truth were known, directly or indirectly due to heavy drinking of ice-water."—*Pittsburg Paper.*

Preservation of Recent Pathological Specimens.

The following is the method of Prof. E. Lund, F.R.C.S., for preserving recent pathological specimens, by placing them in an air-tight vessel filled with the vapour of sulphuric ether, chloroform, or ether and creosote previously mixed with alcohol. Several thick folds of lint, saturated with one of these solutions, were put at the bottom of the vessel, and the specimens were arranged in trays over it, so that the vapour could have free access to each specimen. In this way the specimens were always ready for examination, without being softened or decolourised by immersion in weak spirit and water or other preservative fluids. The cover of the vessel could be made air-tight by a vulcanised Indiarubber ring, on which the edge of the lid was firmly pressed, or by allowing it to dip into a groove around the top of the vessel, which could be filled with vaseline, or, better still, with liquid mercury, if the vessel were not to be much moved about from place to place. It must be admitted that valuable pathological specimens are often lost, or rendered useless, by not having at hand some proper means of keeping them as little changed as possible, and such a hermetically sealed preserving chamber would be found very convenient for the purpose.

Reptiles.

When a Tortoise, a Lizard, a Snake, a Crocodile, a Newt, and a Frog are seen together alive in a zoological garden, or stuffed in a museum, there is not the least difficulty in deciding that they, one and all, ought to belong to a particular group of the animal kingdom, and that they differ from all the other animals called beasts, birds, and fish. Whether they be alive or dead, they convey a repulsive feeling to the mind, which is not felt on examining any other animal. In confinement, the general stillness of most, and the slow crawling motions of some of these creatures, stamp the whole with the title of creeping things, or reptiles. And when they are in their natural homes, where some display an activity of a singular and occasionally rapid kind, the word creeping is so very generally true to nature that the term reptile really does convey the difference between them and the other vertebrated animals. No one can confound any of these creatures with any of the Mammalia. Most observers of birds would object to their

pets being compared with a reptile, and would say that, although the claws and scaly legs of many a bird are not without resemblance to those of the crawling things, there can be no satisfactory comparison between them and the feathered tribes. There is no difficulty in distinguishing between most fish and the reptiles. Common experience, then, without troubling itself about the insides of the creatures, has separated those whose names were mentioned at the commencement of this chapter from the other animals with vertebræ or back-bones. Beast, birds, fishes, and reptiles used to be the great divisions of the Vertebrata. A visit to a collection of living or dead reptiles impresses one with the great number of kinds there are of them, and how very varied are their shapes and peculiar gifts. Some have limbs, others have not ; some have a skin, most are scaled, and a few have a regular armour. They live on land and in fresh and salt water, and some indulge in a kind of flight. Some begin life in the water, and end it on dry land. If they are really to be divided from the other Vertebrata, it must be acknowledged that there are greater differences amongst them in shape and in method of life than there are in any of the other classes already noticed. Very early in the history of comparative anatomy it was shown that the reptiles, popularly so-called, were cold-blooded, like fish, and that it was necessary, principally from the method of life in their youth, or on account of the changes which occur in the anatomy and physiology of their breathing apparatus during their growth, to separate them into two groups ; the reptiles, to which belong the Tortoises, Crocodiles, Lizards, and Serpents ; and the Amphibia, which in many instances lead at some time of their existence an aquatic life, and which may have tails, like Newts *(Tritons)*, or which begin life with a tail, and lose it during growth, like the Frogs and Toads.—*From* "*Cassell's Natural History*" for July.

Marking-Ink for Plant-Labels.

An ink composed of copper, 1 part, dissolved in 10 parts of nitric acid, 10 parts of water being afterwards added, is useful for marking on tin or zinc plant-labels.

To Preserve Star-Fish.

As soon as taken from the sea, they must be placed directly in a large can of sea-water before they have time to throw off their members. They are safe now until home is reached. When there, get a shallow dish, and pour in some spirits of salts, diluted with one-half cold water. Take the star-fish out singly, and immerse them in the liquid quickly. It kills them instantly.

Then place them at once in a dish of clean water, and you will find the star-fish quite perfect, and not dismembered if done quickly. Now place them on a flat piece of board (the underside uppermost) in the sun until nearly dry. Then turn them repeatedly for a short time, and let them remain until thoroughly dry. Sea-urchins can be killed instantly in the same way. They never move after immersion.—V. A. LATHAM.

Boots and Shoes.

Before wearing the boots, give the bottoms a good coating of tallow or coal-tar, and dry it in; then oil the "uppers" with castor oil, about a tablespoonful to each boot; then oil them twice a-week with castor-oil, when one teaspoonful will be sufficient. If the weather should be rainy, or you are compelled to work in water during the day, wash your boots clean at night, hold them by the fire until quite warm, and oil them when wet, and you will have no trouble about your boots getting hard and shrinking up so that you cannot get them on. If the leather should become red, give a coat of ordinary shoe-blacking before oiling. The effect of castor-oil is to soften the leather, while it fills the pores and prevents the water from entering. I have stood in mud and water two or three inches deep for ten hours a day for a week without feeling any dampness or having any difficulty in getting my boots on or off. This process is strongly recommended to the medical profession.—A. L.

Diatoms in Mytilus.

The stomach of the common mussel (*Mytilus edulis*) is a rich source of rare diatoms. In examining the contents of several obtained from the Brussels market, I found 37 species of diatoms, including *Hyalodiscus stelliger*, this latter having hitherto been found in Florida only.—V. A. L.

Cementing Glass Joints.

For cementing glass joints, shellac dissolved in spirit and evaporated to a paste, is best.—V. A. L.

Plant-Sections.

After cutting them with a microtome, place them in turpentine for some minutes to remove the imbedding mixture; then for a time, ranging between half-an-hour and two hours, pass them through a 30 per cent. solution of hypochlorite of potassium, which effectually removes the protoplasm and the products of its activity, and so renders the general structure of the cell apparent

They are then washed in dilute acetic acid and mounted in glycerine jelly or Meyer's fluid, viz., glycerine 1 part, water 2 parts, to 10 volumes of which mixture are added 1 volume of salicylic vinegar, (1 per cent. of salycylic acid in pyroligneous acid).

Growth of Algæ in Aquaria.

When aquaria are exposed to light, the glass sometimes becomes coated with green algæ in the course of two or three days, while at other times five or six or even eight to ten days are needed for the same result. I noticed that every month the vegetation has its maximum of intensity at the time of the new moon. In explanation, I think that vegetable germs lying at the bottom of the water are raised in sunlight by the gas-bubbles which they give off, and which continue attached to them for some time. When night comes on, the bubbles disappear, and the plants sink again; but if there is strong moonlight, the production of gas continues, and they are kept floating. Hence the superabundance met with at full moon.—V. A. L.

Mounting Fresh-Water Algæ.

A very successful process is to be found in using pure glycerine, carbolated. The objects are to be first placed in a dilute solution of iodine (tinct. iodine, 2 minims; water, 1 oz.), two to five minutes; then stained in iodine green, and put into dilute glycerine (10 per cent.), and gradually transferred to thick glycerine.

A Cheap Electric Pen.

A description has been given by Dr. J. Garel of a simple way to make an electric pen, to be used for multiple copying of letters or drawings, to the same effect as the somewhat costly Edison pen.

A tracing of the drawing to be copied is taken upon thin paper; this is then laid upon a piece of common gas carbon. The larger the carbon in proportion to the paper, the less shifting will be required; but a piece of reasonably convenient size may be readily found, and it should be ground to a fair surface. The plate of carbon thus prepared is to be connected with one of the screws of a small induction coil, such as that used for an electric bell. The style for following the design, says a contemporary, is nothing more than a lead pencil, rather hard and brought to a fine point. The other end of the lead pencil is connected by a wire with the other screw of the induction coil, which in turn is connected with a suitable battery. The wood of the pencil effectually insulates the current from the operator's hand. The arrangement being thus completed, all that is necessary is to follow the design

or write the letter upon paper, resting on the block of carbon leaning lightly on the pencil. As the graphite point proceeds, a continuous succession of small sparks flows between it and the carbon, and the intervening paper is accordingly perforated by an infinite number of small holes burned by the sparks. These holes are barely visible to the naked eye except by holding up the paper to the light, but they can be utilised for transferring the design or writing to paper, either by dusting on a powder, or by passing an inked pad over the perforation when laid on the recipient.—*Electrician.*

The Mason-Bee.

The mason-bee employs a variety of materials in the formation of her nest, although the principle of its construction is similar to that of the wasp; the food stored up in it is pollen and honey, instead of caterpillars. It may sometimes be found in the cement between two bricks, in some cases sand or earth and chalk mixed; in others, wood and earth together being employed in building it. A cake of dry mud, apparently thrown against the wall, may be frequently met with, which, on closer inspection, will be seen to contain more stony particles than are usually found in common road mud, and to have a circular hole on the side. This will prove to be the entrance to a mason-bee's nest and will lead to a cell about an inch in depth, and thimble-shaped. Two or more of these cells are contained in one nest, according to the space between the bricks. They appear to be composed of the mortar from the wall, but the external covering, or lump of mud, is evidently formed by little pellets of sand, collected grain by grain and glued together with saliva, as in the case of the wasp, a few stony particles being occasionally intermingled. These busy masons have often, while at their labours, attracted the notice of naturalists, and their proceedings having been closely watched, the quarry, as it were, from which their supplies of sand and earth are derived, has been discovered, and they have been themselves thence traced to their building site. It has been noticed that at the sand-bank the approach of the spectator caused them no alarm, nor did it interfere in the least with their work of kneading and gluing up the pellets, which they quietly pursued as if no stranger were nigh. Not so, however, when followed to their nests, for there they would show fear, and evince the utmost unwillingness to enter, as if feeling that by so doing they were betraying to the foe the stronghold they were erecting for the future protection of their family. They would fly round and round, making wide circuits, and apparently endeavouring to lead the supposed enemy off the scent, thus showing plainly how strong, even in these little creatures,

is the maternal instinct of providing a safe refuge for their young implanted in them by a beneficent Creator. The French entomologist, Réaumur, mentions a variety of mason-bee which, having selected a natural cavity in some stone, forms in it a nest of garden mould, moistened with her glutinous saliva, closing with care the aperture by means of the same material, after the deposition of the eggs, and the honey and pollen requisite for the nourishment of the grub.—*From "The Popular Educator."*

Simple Method of Instantly Killing Water Organisms.

I have killed water organisms, and preserved them for several months, by dropping a 1 per cent. solution of osmic acid ($Os\ O_4$) on the edge of the cover-glass, whilst the slide is under the microscope. Several slides containing desmids, rhizopods, amœba, volvox, I have exhibited thus preserved, together with some very rich gatherings from various localities.—V. A. L.

Extemporised Tracing Paper.

White paper of any kind may be rendered temporarily transparent by moistening it with benzine, in which condition it may be used as tracing paper. After a time, the benzine will evaporate, and the original opacity of the paper will be restored to it.

Flax.

Its uses are various, for it is employed in the manufacture of the most delicate French and Irish cambrics; of the coarsest sail-cloth and tarpauline; of the most beautiful laces from Lisle and Valenciennes and of the heavier sacking and towelling. The folds of softest lawn that deck a bishop's arms and the stout storm-sail that rides out the fiercest gale are both the produce of the same plant.—*Agriculture.*

Staining Nuclei.

Some sections of vegetable tissues, coloured with nigrosine, showed the nuclei of a clear blue colouration, which admirably revealed the details of this structure, while the rest of the cell is unstained. The sections to be stained are allowed to remain in the aqueous solution of nigrosine for a short time, and are then washed in water until the liquid extracts no more colour. They may then be mounted in glycerine, or else passed through alcohol and mounted in balsam or dammar in the usual way.

To Retain the Freshness of Flowers.

The ephemeral character of flowers enhances their attractiveness whilst they present any freshness, and it will prove useful to note that by placing cut flowers in a vase or shallow dish containing water, in which a small amount of carbonate of soda has been dissolved, they will last for several days.

Guaiacum Varnish.

A good varnish is made as follows :—Gum Guaiacum, 2 oz. ; Shellac, 2 oz. ; Methylated Spirit, 10 oz. Powder the Guaiacum and dissolve it in the spirit, and filter ; then add the shellac to the filtrate, and digest in a water-bath until dissolved. This varnish is *not* acted upon by benzole ; it may, therefore, be used for closing cells afterwards to be finished with zinc white varnish. It is not so brittle as shellac dissolved in spirit.

Answers to Queries.

202.—Sun and Moon.—A similar question was asked in the *Scientific American*, June 18, and the following is the reply given by the editor :—"The atmosphere, by its refraction, acts as a lens, producing an apparent increase in diameter near the horizon. Some claim that it is only an optical illusion ; yet when we consider that the atmosphere, as seen from the surface of the globe, is a section of a vast lens whose radius is the semi-diameter of the earth, it is reasonable to assume a small increase in the size of the objects seen through it, and a still greater increase when seen in the obliquity of the horizon, in the same manner as an object is seen at a low angle through a long focus lens, or by turning it edgewise." C.

206.—Aphides.—The best work on the British Aphides is the monograph by George Bowdler Buckton, F.R.S., in four volumes, published by the Ray Society, price four guineas. A useful addition to this is a pamphlet, entitled "British Aphides and their Food Plants," by G. C. Bignell. It is a list of the plants which each species is known to infest, compiled, for ready reference, from Mr. Buckton's work. A very valuable treatise on this subject is the monograph published in the "Transactions of the Linnæan Society" for 1859, by Professor Huxley, "On the Agamic Reproduction and Morphology of the Aphis." It is a very able account of minute observations which he made upon *Aphis pelargonii*, which he found upon the ivy-leaved geranium in his study.

For mounting aphides, Mr. Buckton recommends that the living insects be fastened to the glass slip with a minute drop of Canada balsam, a cover-glass placed upon them, and more balsam run in underneath it. I have tried this method, and find that the insects do not retain their form very well. The density of the balsam appears to cause them to shrink, and an opacity usually arises around each, seriously interfering with its visibility. The following method I have invariably found to be satisfactory in its results:—Place the living insects in acetic acid for one or two days, so as to harden their tissues and prevent fungoid growth. When they are sufficiently hard, put them into benzole (pure benzine) for a few hours, and then mount them in Canada balsam, without pressure, in a cell of glass or block tin, previously fastened to the glass slip with "brown cement." If care be taken, no bubbles of air need arise after putting on the cover-glass. Artificial heat must not be used. If properly mounted by this process, a winged viviparous aphis may be seen to have the wings expanded at right angles to the body, the antennæ in front of the head, the rostrum underneath, and easily seen by inverting the slide, and the natural colours will be retained. The embryos will be readily traced by their conspicuous eyes, being seen as dark spots in the abdomen, and in some cases their entire outlines, rostra, and rudimentary limbs may be observed. F.R.M.S.

220.—Weevils to Mount.—If a medium be used (Canada balsam is the one most generally employed), I think they are generally mounted dry (opaque), or, what I prefer, without the black back ground, and use the diaphragm and a bull's-eye condenser. In this manner both ways may be demonstrated.—V. A. L.

241.—Hardening Tissues.—After the tissues are hardened as required, I pour off the chromic acid mixture, and wash well, replacing it by dilute spirit, made thus:—Methylated spirit, 2 parts; water, 1 part. Let the tissue remain in this for from 24 to 36 hours—never longer than three days; then replace it by pure methyl spirit, where it may remain for an indefinite time; but it will often be found that the spirit becomes cloudy and full of deposits in a few days. In this case, it is only necessary to change the spirit until it remains clear. V. A. L.

242.—Cement for Glycerine Mounts.—Many objects mounted in glycerine are put up in a most slovenly fashion by certain preparers of objects. The object is soaked in glycerine put upon a slide, and covered with a thin glass cover. The excess of glycerine is then absorbed by a moistened but a squeezed-out brush, and a ring of hot and rather thick gelatine solution run round the cover on the turn-table. After thoroughly drying, a ring of white zinc varnish or of asphalt is superposed, the slide being thus

finished, This is the process I believe W. wants, and I certainly advise him to leave it alone; if he wishes to mount objects in glycerine, he should use a gold-size cell, and fix down the cover with gold size. In the course of a year or so, slides mounted in the manner just described, without a cell, are so fragile that on simply wiping the dust off the cover with a soft silk cloth, the thin glass is in nine cases out of ten removed. See the cement given in No. 1 of Vol. I., p. 5. V. A. L.

243.—Cleaning Diatoms.—I would recommend J. A. D. to read the article in *American Journal of Microscopy*, April, 1880. It will answer most of the question required. V. A. L.

243.—Cleaning Diatoms.—The sand must be eliminated by whirling the deposit with water in a watch-glass or evaporating dish. A tea-saucer would probably suit the purpose, but a glass dish is more convenient on account of its transparency. The portion of the deposit consisting of particles lighter than the diatoms must be got rid of by shaking the deposit in water. The fluid is then allowed to stand until the diatoms settle, when the supernatant fluid, holding the finer particles of mud, etc., in suspension, is poured off, and the process is repeated until the diatom mass is clean. Some practice and patience are required in order to obtain good results. E. S. C.

244.—Mounting Mosses.—"The Young Collector's Handbook of Mosses," published by Swan Sonnenschein and Co., price 1s., contains information on the dissection and mounting of mosses for the microscope. E. S. C.

244.—Mounting Mosses.—We will take the pretty moss, *Dicranum heteromallus*. The chief beauty in this moss lies in the capsule, and I may remark here that mosses for mounting should be in fruit, and, what is more, ripe. The peristome is very pretty, and we must try and preserve the capsule uninjured. In its natural state, when growing and quite ripe, the calyptra and operculum are thrown off, the peristome unfolds itself, and the spores issue from the capsule, and either fall to the ground or are scattered by the wind. All this should be borne in mind whilst mounting mosses, and if you can show the spores leaving the capsule, and also the calyptra and operculum, so much the better. Gently shake and remove, with the aid of a small sable brush, as much dirt, dust, and grit as you can; then place the specimens in clean water, and shortly the leaves will expand and look as fresh and green as when growing. Use your brush, and move them carefully and quickly about in the water to further cleanse them. Transfer to a small bottle of water again and shake carefully. Change the water and repeat if necessary. During washing the operculi will

probably fall from the capsules ; therefore, keep a look-out. Take from bottle, examine your specimens, and remove ragged and imperfect portions, if any ; place upon slip, and see if clean with a low power. If so, you will be lucky. Most probably, you will find it necessary to use the brush again, holding the moss under water with one brush, whilst you clean with another. You can try placing them in a saucer, and letting the water-tap drop on them. Now arrange your moss on a slip, unfold and spread out the leaves gracefully and naturally, and with the capsules placed with an eye to artistic effect, as if growing. Put three small beads or portions of broken glass circles for the edges of your cover-glass to rest evenly upon, so as not to rest upon and burst the capsules, and to prevent tilting. Put on the cover-glass and secure with wire clip ; drop the glycerine jelly round the edge of the cover, and it will run under. Now gently heat until ebullition takes place. This operation requires a little practice, but when done successfully it drives out all air-bubbles, liberates a few spores from the capsule, and makes the leaves more transparent for examination. Should the spores leave the capsule in excess and cloud the field, transfer to clean slip and repeat the process. Good glycerine jelly will set immediately, when you may possibly find the boiling has interfered a little with the nice (that is, natural) position of some of the leaves and capsules. If so, warm the slide until the jelly is in a fluid state, insert the needle under the cover, and replace all straight ; at the same time and by the same means, push under and place in position the operculi. Occasionally, there may be a desire to preserve intact the beautiful fresh-green tint of the leaves. In that case, after you have got your moss clean, soak it in glycerine for several weeks until the glycerine has thoroughly permeated and driven out all air from the capsules and leaves. When ready, place a warm slip on your mounting stage, put your moss in the centre, and with the aid of a lens arrange as straight a line as possible ; seeing at the same time any air-bubbles are dislodged either with a needle-point or gentle pressure of some kind. Apply the jelly, dip your cover in warm water, put over all, and gently press down. In adopting this method, you are not very sure of keeping the moss as artistically displayed as you could wish ; but the judicious use of a needle, quickly handled before the jelly sets, will put right any serious defect. Ring and finish as with other slides. This is Capt. P. G. Cunliffe's method, and was used by him in preparing his slides for the Manchester Cryptogamic Society, and which were acknowledged by all to be beautifully-mounted specimens. Bagnall's little work, price 1/-, gives methods for mounting and examination of mosses.

V. A. L.

245.—Staining and Mounting Infusoria.—Picro-carmine does not sensibly colour bacteria, but it colours very clearly the nuclear formations contained in the bodies of infusoria. After colouring, glycerine can be added, and the preparation mounted as usual.

V. A. L.

247.—Salivary Glands of Cockroach.—Your printer has made an error in my note, p. 138, line 17 from bottom, which I fear may mislead "H. B." and other readers. Instead of "exerting GENTLE friction," it should have been "exerting GENTLE *traction*," which is very different. A. W. L.

Queries.

All Questions and Answers should be clearly and concisely written on one side of the paper only, and every question or answer must bear the name and address of the writer. If this is written on the left-hand bottom corner, it will not be published, in which case initials or other signature should appear in the usual place. When more than one answer is sent by the same correspondent, each must be written on a separate piece of paper.

Correspondents, in sending us answers to questions, are desired to commence by quoting the number and title of the question as printed, before beginning their replies.

276.—Staining with Gentian and Methyl-Violet.—Will any reader give me the best and simplest way of staining morbid sections with the above stains so as to prevent cloudy mounts? After the sections are cut with a freezing microtome, *how* are they to be proceeded with for the staining process? PATHO.

277.—Mounting Pollen, etc.—Can anyone tell me what is the best liquid for mounting the pollen of flowers for the microscope; also, is it best to mount sections of stems of plants in Canada balsam? VERINDER.

278.—Zinc Cement.—I have been using white zinc cement lately for finishing off slides, but it does not harden properly or become white as it should do. I find also during this warm weather that in a number of my slides the zinc is running in and ruining many. Can I remount these? If so, how? They are mostly diatoms and histological specimens. The zinc ring of some slides I was looking at, belonging to a friend, I noticed was very wrinkled. Why is this? SCIENTIFIC.

279.—Mounting Gizzard.—I want to obtain and mount the gizzard of a cockroach or cricket. Would any reader kindly give the easiest and best method for an AMATEUR?

280.—Mounting in Balsam.—Will any reader tell me why, after mounting micro-objects in balsam, and leaving them in clips

for a week or more, the balsam will not set; and upon clearing the superfluous balsam away, the air insinuates itself under the edge of the cover, working its way towards the centre, and completely spoiling my objects? A. P.

281.—Gum-tragacanth for Insect Mounting.—How is this used and what are its advantages over balsam? What is the recipe for keeping the fluid good, free from mould, and ready for use, for any length of time? V.

282.—Aperture Table in "J.R.M.S."—Will any reader kindly explain SIMPLY the above table, which appears in every issue of the Journal of R.M.S., by taking one or two examples as 1·52 and 0·98, etc., and greatly oblige the ENQUIRER?

283.—Terminal Nerves.—Will any reader kindly give me a good, reliable method to demonstrate terminal nerves in a cluster of cells in a salivary gland? V. A. L.

Reviews.

BRITISH ART during Her Majesty's Reign. (London: J. S. Virtue & Co. 1887. Price 5s.)

This handsome volume is the Royal Jubilee part of the *Art Journal*, and is beautifully illustrated throughout, every page having one or more excellent engravings. The frontispiece to the volume, a fine Portrait of the Queen, is a splendid etching by E. Slocombe; another well-executed etching by Axel H. Haig, gives a view of the Round Tower, Windsor Castle.

We are told that the *Art Journal* came into existence shortly after her Majesty's accession, and it is now publishing its 50th Vol. The volume before us gives an interesting review of the Fine Arts during the last fifty years. These Histories have been entrusted to men who appear thoroughly to have understood the subjects they have written about. Thus, we have an introductory chapter, by Marcus B. Huish; chapters on the Victorian Era, and on Sculpture, by Walter Armstrong; on the Crown Collection of Pictures, by J. C. Robinson; on the Victorian Progress in Applied Design, by Lewis F. Day; on the Architecture of Queen Victoria's Reign, by Basil Champneys; on Fifty Years' Development of the Graphic Arts, by J. S. Hodson; on Balmoral, by Hugh Macmillan; and on Art Education during the past fifty years, by Gilbert R. Redgrave. The volume forms a suitable book for the drawing-room table.

We have pleasure in informing our friends that a new journal will be published on Sept. 1st, to be called THE NATURALISTS' MONTHLY: A Journal for Nature-Lovers and Nature-Thinkers. It will be edited by Dr. J. W. Williams, M.A., and will contain—Original and Recreative Papers on Popular Scientific Subjects, by well-known writers; Articles on the Distribution of Animal and Plant-Life in the British Islands; Monographs on Groups generally overlooked by the Field-Naturalist, as the British Fresh-water Worms and Leeches in Zoology, and the Lichens and Mosses in Botany; Accounts of Scientific Voyages and Expeditions; Biographical Lives of the

Greatest Scientific Men; "The Editor's Easy-Chair"—a Monthly Chit-Chat on the most important Scientific Questions of the day; Reports of the Learned Societies; General Notes and Correspondence; Reviews of the latest Works and Papers; Answer and Query Column for Workers.

From the list of contents of the first number, which has been submitted to us by the editor, we feel sure that the new journal will prove a welcome addition to the library of our readers, the names of many of the contributors being well known. The price will be 6d. monthly, and will be published by Walter Scott, London.

Answers to Correspondents.

R.—The Fungus on grass which you sent to us for identification is *Epichloe typhina*, one of the *Sphæriacei*. You will find it fully described in Cooke's "Handbook of British Fungi," p. 773.

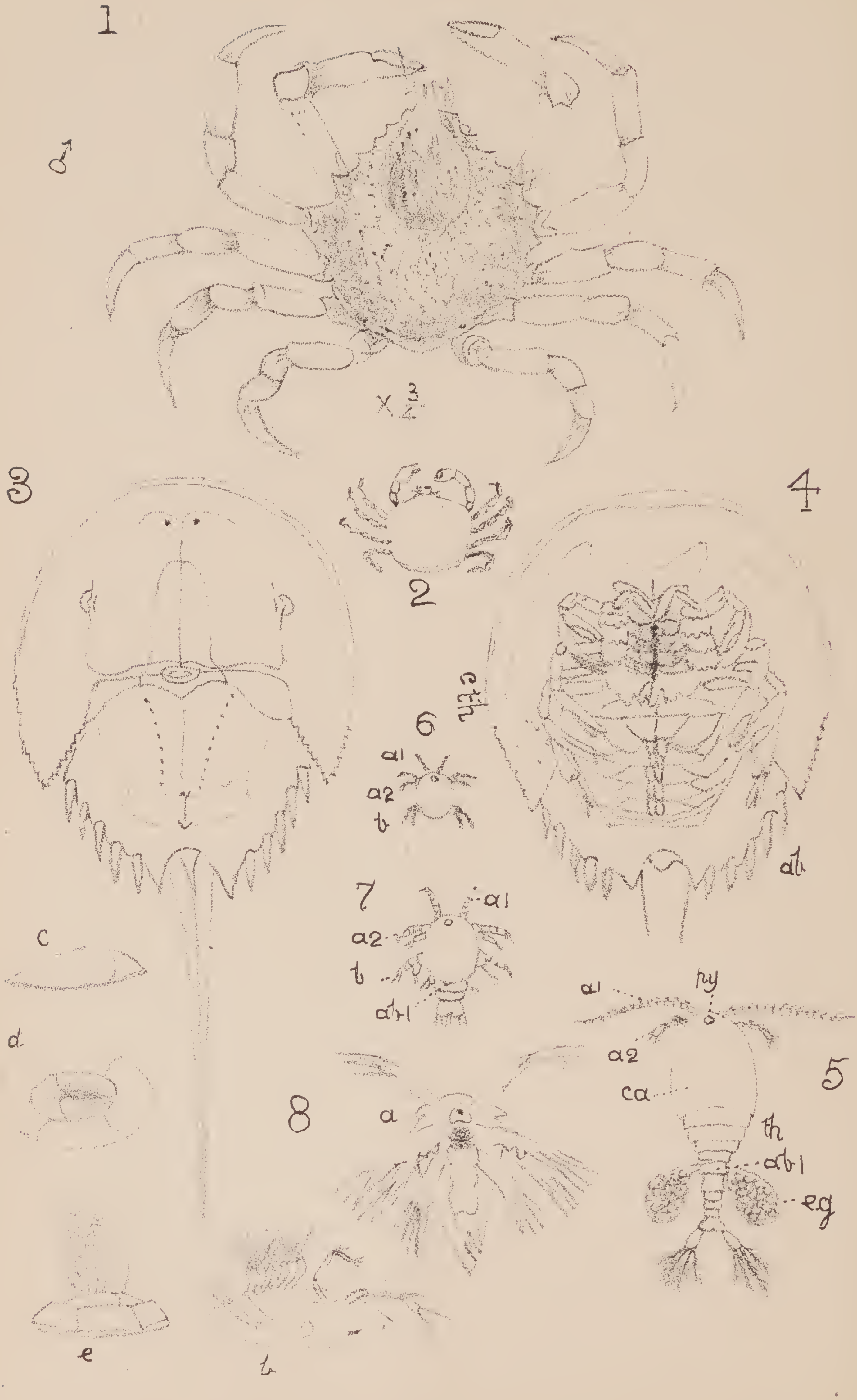
MICRO.—Write to Mr. W. P. Collins, 157 Gt. Portland Street, W., for his catalogue; it contains a list of works relating to every department of Microscopy.

H. S.—The fifth edition of Dr. M. C. Cook's "Microscopic Fungi" was published last year, by W. H. Allen & Co.; we have not heard of a more recent edition.

☞ Our contributors will oblige by sending Answers and Queries as early in the month as possible.

Sale and Exchange Column.

[All Exchange Notices are inserted free; for Notices of Books or Scientific Instruments or Accessories offered for sale, a charge of 4d. for the first 12 words and 1d. for every succeeding 3 words will be made.]



Crustacea.

The Scientific Enquirer.

SEPTEMBER, 1887.

Crustacea.

By Alpheus Hyatt.

Chapter VII. Plate VIII.

THE order Copepoda is represented by the genus Cyclops, found in great numbers in fresh water, and often seen in our drinking water.

The body of Cyclops (Pl. VIII., Fig. 5) is shaped somewhat like a pear. In the middle of the front of the head there appears to be a single eye (*py*), though closer observation proves that this eye is really double. The two pairs of antennæ (*a* 1, *a* 2) are the chief organs of locomotion. Following the antennæ come the mandibles and two pairs of maxillæ, and next to these the five pairs of swimming-feet, most of these being invisible from above. The egg masses attached to the first abdominal ring are very characteristic of the animal (Pl. VIII., Fig. 5, *eg*). The similar form of the young or Nauplius form in all the Crustacea may be seen by comparing (Pl. VIII., Fig. 6) the young of Cyclops, with (Fig. 8 *a* of the same plate) that of the barnacle, both of them having the three pairs of appendages (*a* 1, *a* 2, and *b*). Fig. 7 represents an older stage, during which the abdominal segments make their appearance. See also the young of *Lernea branchialis* (Pl. IX., Fig. 4).

Closely allied to the Copepoda are the Epizoa, or "fish-lice." This division of parasites contains a great number of forms, which have been so entirely changed, and often so degraded in structure, that it would not be possible to recognise them as belonging to the class if it were not, as in the barnacles, that the young are in their early stages of development true Crustaceans (Pl. IX., Fig. 5). They are parasitic, living on or in other animals, and specimens of some of them may be found on fishes, attached to the gills, or hanging from the skin just behind the fins, with the forward part of their body deeply buried in the flesh. Having no need of eyes, appendages, or of stomachs, as they take their food directly by

suction, or through the skin of the body by absorption, they lose most of these organs, or all of the more important ones, and become in some cases mere sacks without shells or jointed appendages, having no likeness to any normal articulated Crustacean. *Lernea branchialis* (Fig. 5 of this plate) is one of the most degraded forms of this order, and is not uncommon on the gills of cod-fishes. Its body is not segmented, and ends in two long egg-masses. It is destitute of locomotive appendages and sense-organs. The parts around the mouth are modified into root-like appendages, and these are buried in the flesh of the animal upon which this parasite feeds.

The curious extent to which parasitic habits may alter the organisation can be studied in the very familiar animal, the little oyster-crab (Pl. VIII., Fig. 2), which can be obtained from oyster-openers by the hundred, if wanted. In this case a Decapod, or true hard-shelled crab, living inside the oyster and browsing on the food accumulated by the surfaces of the gills, loses its power to make a hard, thick shell, and becomes an albino, being colourless. The terminal sections of the legs are hooked, and used to hold on with instead of for walking; the arms are short and weak, as is suitable to their style of feeding. It does not seem to injure the oyster materially, though it sometimes causes a slight distortion of the gills. It is not a true parasite, feeding on the blood or juices of the oyster, but a sort of companion, a commensal parasite. The males are generally free and very rare, and females alone are found with the oysters.

The genus *Branchipus* (Pl. IX., Fig. 3), belonging to the Branchiopoda, is found in great numbers in rain-pools and fresh-water ditches in the early spring. It is a very curious animal and interesting to children on account of its habit of swimming with its back downward, and the oar-like appendages with which it moves along.

Specimens of the order Ostracoda are found frequently in our fresh-water ponds, but these are too small to be studied by the unaided eye. They closely resemble small bivalve shells, the similarity being due to the shape of the carapace, which also sometimes has lines of growth like those of the shells.*

It only remains for us to compare the two great classes, Worms and Crustacea. In the higher worms, such as we have used to illustrate the group of Vermes, we find an elongated body, the two ends of which are often similar in form, though distinct in function. The consolidation of a few of the anterior rings has produced

* Excellent figures and descriptions of these can be found in Morse's book, already cited.

in many genera a cephalic or mouth region. The skin of the segmented body is covered with a chitinous cuticle, and bears either setæ, or unjointed appendages, or both. Respiration is effected by the general surface of the body, and by the appendages, and no heart comparable with that of the Crustacea is present. Adult size is attained by the development of rings between those already formed near the posterior end of the body—*i.e.*, between terminal and subterminal rings.

In the Crustacean, on the other hand, the number of segments is less variable, and the full complement is attained in the early stages of growth. The body is shortened, and the two ends are not only distinct in function, but very different in form. A coalescence of a number of the anterior rings has produced a complicated cephalic or mouth region, and in the higher forms a cephalothoracic region. The segmented body in most forms is covered with a hard crust or shell, and bears jointed appendages. Respiration is usually carried on by gills, a heart is generally present, and growth is made possible by repeated moults of the unyielding shell.

Short Papers and Notes.

Spiders.

By J. C. W.*

FEW creatures are looked upon with greater indifference, if not abhorrence, by people unacquainted with natural history than the spider, notwithstanding the fact that tradition has ascribed to it the victory of Bruce of Scotland and the preservation of Mahomet. But to those who think nothing too mean for study, if it be the workmanship of our all-wise Creator, a short account of the spider may not be deemed unacceptable.

Spiders, of which there are many varieties, differ somewhat from insects proper. Their body is composed of two pieces, the head being joined to the thorax; they have eight feet, and six, but more generally, eight eyes; their cephalothorax appears to be composed of a single segment, and is covered with a kind of horny buckler, to which the abdomen, consisting of a soft mass, is attached. Their mandibles terminate in a hook, having at its extremity a small aperture, which serves as a channel for the

conveyance of poisonous juice, which they eject into their victims. Their legs have several joints (the fourth pair being covered with bristles which they use in forming the flocculent silk used for ensnaring their prey), and each tarsus ends with two (or three) curved, finely toothed, claws, which act as hooks for tightening the lines of their webs. For the purpose of constructing their snares, Nature has supplied the spider with a large quantity of glutinous matter within its body, and with spinning glands for converting it into silken threads, of whatever diameter the creature desires.

The female lays several hundred eggs in a season; these she deposits in a sort of bag, spun by herself, of considerable strength. This bag she guards with wonderful care until the young are hatched, and are able to look after themselves. The young commence business on their own account almost before they are discernible, and before they have strength enough for the conquest.

The sexes do not dwell together in concord except in one species: the *Agelena labyrinthica*. In all the other kinds there unhappily exists a tendency to devour one another; in fact, it frequently happens that the female makes a meal of her spouse soon after the wedding.

Each species constructs a different kind of web, but none of them excel that of the *Epeira diadema*, in point of architectural beauty, and, therefore, the writer ventures to attempt a brief description of its construction.

The *Epeira*, by a quick movement of her posterior legs, first throws out a number of fine threads, which are wafted by the wind to some plant, or tree, or wall, and being sticky one of them at once adheres; whereupon she pulls it to test its stability, and if satisfied makes it secure. This done, she proceeds to construct the lower foundation and boundary lines; the latter being formed by the spider dropping from one point to another, and attaching a thread at proper regulated intervals, until the circumference is completely enclosed; she then fills in the area with a series of equidistant lines, which she afterwards converts into ladders by bringing a line from the centre in spiral form; each step being attached to the radial line by a drop of gluten. The centre of the web is then connected by two or three threads with the leaf which is to form the retreat or hiding place of the spider. These threads, being held by the spider, telegraph to her any movement that takes place on the snare.

While speaking of the *Epeira*, it may not be inopportune to mention an instance of its cunningness and courage.

The spider in question had selected a spot near the writer's parlour-window for the scene of her labours, and had just finished her snare, when a large wasp, who had been buzzing about it for

some moments, either through carelessness, or else contempt for the smallness of the creature, alighted on the web. Instantly the spider flew to the attack, but her adversary was so strong, and its sting so formidable, that she was unable to get to close quarters; indeed, for a few moments, all her energies had to be devoted to repairing the broken fortifications, and spinning additional stays to strengthen the web, and prevent the wasp from escaping. However, after frequent rebuffs, she resorted to a stratagem which secured her the victory.

She first spun a strong thread, and carrying this in her foreleg, approached the wasp and tempted him to strike her with his sting. On his doing so she quickly extended her leg, attached the thread to his body, and then secured it to the web. Repeating this *ruse* successfully several times, she at last had him bound down much in the same way as Gulliver is represented to have been made captive, when he got among the Liliputians. The battle, which had lasted upwards of twenty minutes, now quickly terminated, for with a sharp spring the spider alighted on the back of the enemy, and gave him his *coup de grace.*

The space at the writer's disposal will not permit of his enlarging on the subject at this moment, but he trusts that the few observations he has been able to make, will be sufficient to dissuade the reader from regarding the spider as unworthy of notice. Let us remember that even the smallest objects in nature have been planned with consummate wisdom by our Almighty Creator.

"The Grass of the Field."

(From *The Daily Telegraph.*)

It ought by good rights to be summer-time when the paragraphs which follow are perused. Those who read them should, in justice to the subject, be lying under a cloudless sky of June, couched lazily in the deep, soft herbage of an English pasture-field. Above their idle heads should wave, in the warm breeze, the ivory-white blossoms of the meadow sweet, the fiery-flowered poppies, the long purple cuckoo-flowers, the downy seed-spheres of the dandelion and the broad-leaved docks, diversifying that green carpet of grass, ripe with waving spikes and panicles, for the scythe or mowing-machine. Then could the happy idler be the better invited to raise himself upon his elbow and to study a single square foot of the pasture nearest to him. Nothing at first sight would perhaps seem to his mind so commonplace. Yet in that little area of soil might be perceived, by such as have eyes to see, not only one of the chief botanical miracles of nature, but a

costly, curious, and most elaborate earth-garb, which was not folded about the planet that we inhabit until incalculable ages had prepared the surface, and subtle vegetable selections had produced the requisite conditions. In that small area, moreover, which the summer idler would have under inspection might be discerned one of the leading secrets of the final development of animal and insect life on our globe, to say nothing of the fact that—tiny and insignificant as the separate blades and seed-stalks of the grass might appear—nine-tenths of the entire vegetation of the earth belong to the plants therein represented, while every square foot and inch of herbage in itself is the outcome of a battle for existence, as active, momentous, and long-continued as, perhaps, any in the history of the evolution of living forms. Of the *Gramineæ* alone there are reckoned 3,200 species, ranging from the delicate, hair-like seed-heads of "shepherd's purse," which bend if a lady-bird alights or a drop of rain falls upon them, to the magnificent clumps of bamboo, which tower 100 feet high in the tropical jungle, and the dense clusters of water-grass and giant reeds of the Nile or Amazon. To the vast family of those same tender green blades belong all the cereals consumed by the earth's inhabitants—wheat and barley, rice, maize, and millet, for all of these are offshoots, or at least relatives—of the grass of the field, to say nothing of those kindred plants which produce fibre and paper material. That all our flocks of sheep and herds of cattle depend upon the verdant mantle of the turf is well enough known even to the little children playing knee-deep amid the flowers which enamel every meadow in summer. But, beside the beef and mutton, which we owe to the herbage; beside the bread baked from the waving English wheat, and the ale brewed from the home-grown bearded barley, we import in corn, rice, maize, and millet, and other food-seeds, the fruit of foreign grasses, nourishment for man and beast, to the value of £70,000,000 a-year. As much as £25,000,000 worth of sugar comes to us from tropical cane-fields, besides fibre, rope, and other grass-products. So it is, that, knowing the value of "the grass of the field," we keep here in England a full half of the soil under pasture, of a natural crop made up of so many tiny separate plantlets, that, in the single square foot spoken of above, there will be, perhaps, more than 1,000 individuals. Few, and scattered indeed, are the botanical rivals which manage to exist amid these modest but dominant grasses. Seeds of alien trees, such as fir cones, beech-nuts, and the rest, cannot find any foot-hold in the close-woven emerald carpet, or are crushed by the hoof which does not hurt the herbage. In a word, "the grass of the field," humble as it seems, is really a proud and widespread conqueror, and Nature, if

she could only be questioned, would declare that she has given nothing to man more valuable, and also nothing which it has taken more pains on her part to create and develop than this same close-woven vestment, tender and obscure, of the plains and downs, which makes so soft and fragrant a couch for lazy dreamers in summer.

A lecture lately delivered by Mr. J. Starkie Gardner, F.G.S., adduces good reasons to show that it was, nevertheless, very late in the geological record before a blade of this grass, great or small, existed on the earth's surface. Meadows and lawns, grassy jungles, prairies and savannahs, were, in point of fact, wholly unknown until the time of the Upper Eocene. Our globe, in the long primary ages, was either clothed with rough thicket and rude forest, or with dull and barren patches of equisetum and the moist, unlovely vegetation of the coal measures. To replace these there was needed some elastic, indomitable, patient-minded plant, which would grow everywhere, heedless of forest fires, changeful climates, or the trampling of bulky primæval creatures. The grasses stepped into the vacant place, able to grow with little soil or much, with short roots or long ones, beneath the shade of trees or in the open. Yet, even with these qualities, not until the Upper Eocene was laid do we begin to find the small blades and seed-vessels of fossil grass and the associated meadow plants. In the Eocene strata, as at Aix, relics of grass begin to be discovered, together with clover, and, later on, with strawberry, meadow-sweet, rose, liquorice, lucerne, and trigonella. The fossil grasses become quite abundant in the gypsum beds of Aix, as well as reeds and spikes of wild barley. They are everywhere prevalent in the Miocene basins of Marseilles, Sinigaglia, and Oeningen in Switzerland. In the last-named place, specimens of an undeveloped millet, and of a primitive rice, have been obtained, but none, even there, apparently, of the enormously valuable groups, the *Phalarideæ*, including the maize; the *Agrostideæ*, including the "bent grasses"; the *Avenaceæ*, or oat family; the *Hordeæ*, including wheat, barley, and rye; and the *Andropogoneæ*, which comprise the sugar-cane. Briefly, the oldest grasses are not, by any means, geologically ancient, and, if we should be puzzled at their world-wide distribution, the fossil-botanist justly reminds his audience that this is doubtless due to the enormous number of individuals, the hard nature of the seeds of grass, and the avidity with which migratory and other birds feed upon them. Their hardiness, capability of resisting immersion in salt water, and power of vegetative reproduction, would greatly assist their spread. Darwin has proved that the seeds of various *Gramineæ*, which have farinaceous albumen, will bear two or three months' immer-

sion in sea-water without losing their germinative power. The secret, in fact, of the triumph of the grass over the earth's face was its apparent insignificance. The *Sporobolus Indicus*, which occurs all over the warm regions of Asia, Africa, America, and Australia, propagates by a seed of which eight will go to the length of a barleycorn.

But these tiny germs and what has come from them were none the less destined in the fulness of time to overwhelm and revolutionise the aspect and history of the globe. The development of the animal world waited for them, and was truly impossible without them. Just as we find no grass in the strata until late, so, naturally, we come upon no remains of grass-eating creatures till earth was ready for them. Horsetails and ferns and rushes had hitherto covered the open spaces, and such vegetable-feeders as existed broke down the forest fruits and browsed its lowest leaves. Then came silently and subtly the grass, and, with it, a new creation in the animal and insect world.

Mr. Gardner says :—"The influence on the habits and development of insect life exerted by the first appearance of grasses must have been prodigious. Until there were grassy glades and flowery meadows, butterflies, the brightest coloured of the beetles, the grasshoppers and bees—in fact, all that is most beautiful and charming in insect life—could not have existed. A sudden and brilliant transformation must have taken place when the dull-hued scorpions, spiders, cockroaches, *Phasmidæ*, and the many large ephemera and dragon-flies, with the crickets and wood-beetles which infested the wierd old cryptogamic forests, ceased to occupy the front rank." Fossil butterflies and flower-haunting creatures begin, accordingly, to be found along with fossil grass blades in the later strata. Bees and ants also come into the record of existence, with specimens of almost all our modern insect tribes. "The remains of beetles are scattered throughout most of the Tertiary strata, and manifest, according to Heer, a great increase in the number of pasture and flower haunting types. Among them may be instanced the genera *Onthophagus* and *Geotropus*, found at Oeningen and Aix, whose domestic economy requires respectively the presence of cow and of horse dung, and therefore of grass-feeding mammalia and supplies of grass." In a word, with the grass of the field, came, by parallel development, upon the earth the grazing animals, the bloom-haunting butterflies, and, in the botanical kingdom, the ancestors of those plants which, like wheat, rice, and millet, were adapted to feed the swarming millions of mankind, or, in the form of giant bamboos and symmetrical swaying reeds, to help him to build and to equip him for warfare or the chase. Says the geologist :—"The evidence of

animals and insects supports the view that herbaceous grasses were absent or rare even in the Middle Eocene period. With the testimony before us, we are justified in believing that grasses first became a prominent element in the floras of both hemispheres towards the close of the Eocene, but it is by no means improbable that they were established in Spitzbergen at an earlier period."

Who that knows and understands all the significance of these scientific facts which make a new point of departure in the history of both vegetable and animal life on the face of the globe will not think differently and more gratefully of the grass when next he lies upon its tender verdure? This turf, that is softly folded round the wings of the skylark as he sinks back from the sky to his nest—these grass-blades, which joyously spring wherever earth has an inch of unoccupied surface—possess the secret of progressive creation, and are an afterthought and a masterpiece of the Power which makes and furnishes habitable worlds. Is it worth while to wrangle so much about the Name which should be given to that divine Inventor, when the work is so wonderful, its beginning so unexpected, and its outcome so far-fetched and invaluable? To revolutionise the planet in the direction of beauty, use, and progress, Nature dropped a grass-seed on the Eocene, and, lo! all our world was in way of magical transformation! The tiny, overlooked, aggressive grass marches over the old strata with a million green spears to every rod of soil, and conquers the orb in the interests of man who is to come. Moreover, while the grass thus silently peopled the air with fluttering creatures of exquisite colour and loveliness, and lent itself to the secret plot for ever going on between flowers and insects, to which we owe the diversity of the floral world, other battalions of the all-conquering *Gramineæ* overspread the globe, to dower its forthcoming inhabitants with the wheat and rice and millet, which should by-and-bye nourish them. Says the admirable lecture from which we quote:—"The introduction of an aggressive type in vast numbers, and of habit different to that of pre-existing vegetation, exerted an influence on terrestrial life that is without parallel, the immediate effects of which were: the development of meadows and prairie vegetation as distinct from that of marsh, scrub, and forest; the introduction of vast herds of grazing mammals, as distinct from the herbivorous mammals previously existing and of the larger kinds of carnivora which prey on them; the creation of meadow insects, distinct from aquatic and woodland forms, including butterflies, bees, and grasshoppers, etc.; and, lastly, the introduction of a food-supply, both animal and vegetable, in the absence of which it is doubtful whether man himself would have

been enabled to reach his present stage of development." Thus the very history of man is bound up with the growth of grass-blades, and a turf of "fox-tail" or of *Festuca pratensis* has in it all the philosophy of Life.

Notes on Varieties of Eyes.

Birds of flight, as the condor, eagles, vultures, and carrion-seeking prowlers of the feathered race, have telescopic vision, and are thus enabled to look down and discover their unsuspecting victims. As they approach noiselessly from above, the axis of vision changes, shortening, so that they see just as distinctly within one foot of the ground as when at an elevation of one mile in the air. This fact explains the balancing of a fish-hawk on its pinions half-a-mile above a still pond watching for fish. When one is selected, down the savage hunter plunges, the focal axis varying as the square of the distance, giving the hawk a distinct view of its prey always. As they ascend, the axis is elongated by a curious muscular arrangement so as to see far again. Snails have their keen eyes at the extremities of flexible horns, which they can protrude or draw in at pleasure. By winding these organs round the edge of a leaf or a small stalk, they can see how matters stand on the opposite side. The hammer-head and shark has its wicked-looking eyes nearly two feet apart. It can bend the thin edgings of the head on which the organs are located so as to examine the two sides of an object of the size of a fully-grown cod-fish. Flies have immovable eyes; they stand out from the head, like half an apple, exceedingly prominent; instead of being smooth hemispheres, they have an immense number of facets, resembling old-fashioned glass watch-seals, each one directing the light straight to the optic retina. This explains why they cannot be approached in any direction without seeing what is coming. V. A. L.

The Hop-Louse (Phorodon humili).

Professor Riley, the entomologist of the U.S.A. department of Agriculture, has made public the result of an exhaustive personal investigation into the habits of the *Phorodon humili*, or hop-louse. His discoveries are expected to prove of great value to hop-growers, as he has succeeded in learning the habitation of this plant-pest during the winter months, and tracing it through the various stages of insect-life. Before the investigation, it was not known how or where the insect survived the winter. As a result of his inquiries, Prof. Riley has satisfied himself that the eggs laid

by the female at the close of the summer are deposited in plum-trees, where the insect hatches in the spring, and resides until the third generation. This third brood, unlike its predecessor, is winged, and immediately after development abandons the plum-tree and attacks the hop-vine. In the autumn a counter migration from the hop-vine to the plum-tree occurs, the winter eggs are deposited, and the cycle of life goes on in the same way. It is a notable fact that in regions where the cultivation of hop-vines is a new industry, the growers have had complete immunity for a while from the pest. In California to-day they are not troubled by it. Prof. Riley believes that the *Phorodon humili* has been brought to this country (America) from Europe on plum-stock; and there is reason to believe that the *Phylloxera*, the dreaded grape-pest, was carried from this country to Europe on grape-vine cuttings. Therefore, California hop-growers are warned to beware of importing plum-stock from eastern hop-regions. These discoveries render it possible to check the ravages of the hop-louse, either by the use of insecticides in the spring-time before the insect has reached the winged state, or by the destruction of the sheltering plum-trees. The experiment will be continued with a view to protecting the hop-vines after they have become infected with the hop-louse.—*Science.*

To Dry Plants so as to Preserve their Colours.

The materials required are common cartridge-paper, thick, white blotting-paper, cotton wadding, and millboard, all cut to the same size. The plants should be gathered in dry weather and soon after the flowers open, when their colours are brightest. Succulent plants—such as the daffodil, orchis, or stone crop—should be put into scalding water, with the exception of the flowers, for a minute or two, and then laid on a cloth to dry. Arrange the specimens and papers in the following order:—Millboard, cartridge-paper, wadding (split open, and the glazed side placed next to the cartridge-paper), blotting paper, the specimens having small pieces of wadding placed within and around the flowers, to draw off the moisture as quickly as possible; blotting-paper, wadding as before, cartridge-paper, and millboard. When the specimens, etc., are thus arranged, heavy weights should be laid upon them—about 30 lbs. the first day and 60 lbs. afterwards. Remove them from under pressure in a day or two; carefully take away all the papers, etc., except the blotting-papers between which the specimens are placed, put these in a warm air to dry, whilst the removed papers, etc., are dried in the sun or by the fire. When dry, but not warm, place them in the same order as before, and put all under the heavier pressure for a few days, when, if not

succulent, they will be dry. Flowers of different colours require different treatment to preserve their colours. Blue flowers must be dried with heat, either under a case of hot sand before a fire, with a hot iron, or in a cool oven. Red flowers are injured by heat. They require to be washed with muriatic acid, diluted in spirits of wine, to fix their colour. One part of acid to three parts of spirit is about the proportion. The best brush with which to apply this mixture is the head of a thistle when in seed. As the acid destroys a hair pencil, and injures whatever it touches, except glass or china, it should be used with great care. Many yellow flowers turn green even after they have remained yellow for some weeks. They must, therefore, be dried repeatedly before the fire, and again after they are mounted on paper, and kept in a dry place. Purple flowers require as much care, or they will soon turn a light brown. White flowers will turn brown if handled or bruised before they are dried. Daisies, pansies, and some other flowers must not be removed from under pressure for two or three days, or the petals will curl up. As all dried plants, ferns excepted, are liable to be infested by minute insects, a small quantity of the poison, corrosive sublimate, dissolved in spirits of wine, should be added to the paste, which it will also preserve from mould. The best cement for fixing the specimens on to the paper or cardboard is gum-paste. It is composed of thick gum-water and flour mixed in warm water, by adding the two together warm and of a consistency that will run off the hair pencil.

Among the Sandhills.

Half-way between a great northern port and a watering-place which is becoming great there lies a rather remarkable tract of country. Before it was fairly opened up by the railway, which now passes through it, it must have been a curiously out-of-the-world place. Even the tide of the Reformation seems to have lost itself on reaching these sandhills, and all the people about—great landlords and simple peasantry—have remained Roman Catholics to this day. One great hall in the neighbourhood has its private chapel joined to the house, and it is large enough to hold 500 worshippers. But changes have come with time and with increased facility of communication. Villas are being built along the line of railway and at the edge of the sandhills. A new people with very different tastes and opinions are invading the land, and bringing the ideas of a great town into this primitive corner. But it will be difficult to change or spoil the sandhills themselves. They extend over many miles, and vary from half-a-mile to a mile in depth, before reaching down to the barren,

monotonous shore, up which the sea scarcely cares to climb, and which is constantly gaining fresh ground. The great interest of the sandhills is the slacks. They are more frequent in some parts than in others, for there are miles where the hollows are all sand and star-grass. But every here and there the hills have receded and formed a little flat valley, where there is something like soil, and where the rain lodges and mosses grow. This is slack ; and in the Lancashire slacks may be found some of the most beautiful and certainly one of the rarest—perhaps the very rarest—of English flowers. But the slacks themselves are curiously capricious in the wild flowers that are to be found upon them. Some of them are best in early summer, when the little yellow lotus, the birdsfoot trefoil, is out, and there is a perfect field of cloth of gold, which is brighter even than celandine or buttercup. The early purple orchis, Ophelia's "long purple," is very generally distributed ; but it is only here and there that they grow so quickly as to give a colour to the slack. Now they are all but over. But we did not come for these, nor for the pink centaury, which is just beginning to open its blossoms, nor even for the *Chlora perfoliata*, or yellow centaury, as it is sometimes called, which is a striking and by no means a common flower. The real treasure of the slacks is the *Pyrola rotundifolia*, or round-leaf winter-green, which is rare everywhere, but of which this particular variety, *arenaria*, or the sand pyrola, is to be found nowhere except among the slacks of the Lancashire sandhills. It is, moreover, only in certain slacks that it is to be found, and there often only in particular nooks and corners. Our guide, however, has known where to find the particular slack and the particular corner. The white stars of the grass of Parnassus are very abundant just here, and the dwarf willow is thickly tufting the soil ; and right among the grass of Parnassus and the willow we saw for the first time this rare pyrola. It grows straight up from the round leaves which surround the base of the stalk. The stalk itself is a sort of chocolate red, and the creamy white blossoms standing out from it form the most delightful contrast. Then, too, they are scented with a most peculiar perfume, which perhaps is more like that of the *Clethra arborea*, or lily-of-the-valley tree, than any other which I can recall. The pyrola is here growing in profusion, and as it is both out of the way of the ordinary tourist, and by no means easy to find, we may fairly hope that it will be long before it is exterminated, as so many rare species have been in other and more accessible places. As we leave the sandhills for the pasture-land, we can see another rare flower, the wild *Œnothera*, or evening primrose, which originally came from North America, and which, like the potato, is said to have owed its existence on these shores to the accident of a shipwreck.

Colouring Infusoria during Life.

With the exception of the opalines and the *Haptophrya*, all the ciliated infusoria can inject or take in particles of carmine or indigo from the water in which they live. In a weak solution of Guinoliéne blue or cyanin, the organisms will take a faint-blue colour so long as thirty-six hours before death, but with this exception, the cells do not become tinged till life is extinct. The colour is deepest in the fatty granulations of the protoplasm, and is scarcely seen in the nuclei, while the vibratile cilia, the cuticle, and the pulsating vacuoles are intermediate. This renders it easy to watch the phenomenon of the division of the nucleus in the living animal undergoing division, and affords another proof of the difference in composition between cellular and nuclear protoplasm. The aqueous solution of cyanin which should be used for these experiments is an excellent re-agent for fatty matter. An alcoholic solution, like osmic acid, fixes the form of many species (*Comptes Rendus*). V. A. L.

Storm-Glasses.

The fluid in these glasses is composed of—Camphor, $2\frac{1}{2}$ drachms; alcohol, 11 drachms; water, 9 drachms; saltpetre, 38 grains; sal ammoniac, 38 grains. Dissolve the camphor in the alcohol, the salt in the water, and mix the solutions together.

Answers to Queries.

190.—The Aurora Borealis.—Lieutenant Weyprecht thinks that the Aurora Borealis is an atmospheric phenomenon closely connected with the condition of the weather. Almost every intense display which he witnessed in the Arctic regions was followed by a storm. The prevalent colour of the Aurora near the North Pole is white, with a greenish tinge; the prismatic hues appear in the grander displays in which the visible motion is greatest. Three general forms of Aurora were noticed: the regular arc, passing from the southern to the northern horizon and disappearing there; simple bands of light, varying in shape and intensity; and the corona, radiating from the magnetic pole.

A. L. S.

190.—Aurora Borealis.—A novel theory of the formation of the Aurora Borealis has been advanced by Prof. J. H. Groneman, in the German *Astronom. Nachrichten.* He suggests that there may be fragments and particles of magnetic substances, such as nickel and iron, moving around the sun, which are rendered incandescent

by friction upon entrance into the earth's atmosphere, and then become visible in the form of auroral light. B.

251.—Insect Dissections.—G. H. J. will have to consult the papers scattered in the various scientific journals. He will, however, find a fairly good description of insect anatomy in Thompson Lowne's "Anatomy of the Blowfly," and with the aid of the very well-known text-books on comparative anatomy, as Huxley, Owen, and Gegenbaur, he will easily be able to make out and note if he should wish any small structural difference existing between Blow-fly and Crane-fly anatomy. A most helpful work he will find is Packard's book on "Insects." He should dissect under water in a glass tray, and by needles using a "bull's-eye," to throw more light on the dissection.

J. W. Williams, M.A., D.Sc.

252.—Pineal Gland as proved to be the Third Eye.—The papers that have been published on this subject will be found scattered among the later numbers of *Nature* last year; these on *Hatteria punctata*, and by Spencer and de Graaf; Mr. Spencer also contributed to *Q.J.M.S.* for March a beautifully illustrated article on the same. Another paper on "The Parietal Eye in Fishes," appeared in *Nature* on July 14, 1887, communicated by Mr. J. Beard; and a letter from Mr. G. Macloskie to *Science*, No. 230, gives a good description of the parietal eye, in the common pine-tree lizard of America (*Sceleporus undulatus*).

J. W. Williams, M.A., D.Sc.

255—Micro-Polariscope.—There can scarcely be any advantage gained by revolving the analyser as well as the polariser, as the relative positions of the plane of polarisation of the polariser and analyser cannot be effected thereby, except in the increased velocity of rotation. If the analyser is placed immediately over the objective, a larger field of view is obtained than if it is connected with the eye-piece, but less light reaches the eye. If the analyser is connected with the eyepiece, the field is much restricted, but more light is gained. The former position would, therefore, seem to be desirable for obtaining fine effects with popular objects, and has moreover the advantage of allowing any eye-piece to be used; whilst the latter position is suited for delicate investigations on minute objects where the amount of light is a matter of great importance. E. S. Courroux.

261.—Embryo of Chick.—I believe the latter statement to be correct. A. M. M.

276.—To Stain with Gentian and Methyl-Violet.—Harden the tissue in alcohol, and deeply stain with an alcoholic solution of gentian violet, strongly acidified with acetic acid. The excess of

colour is removed by the alcohol, and the preparation mounted in balsam. If mounted in glycerine, the colour soon fades, but lasts for years in the balsam. It also holds in acetate of potash. (See Vols. IV. and V. of *Journal of Microscopy.*) If properly dehydrated, the enquirer need have no fear of cloudy mounts. V. A. L.

277.—Mounting Pollen, etc.—I would recommend "Verinder" to dry the pollen and then mount it as a dry object. If the pollen is very dark, mount it in Canada balsam. B. T. E.

278.—Zinc Cement.—I should think the cement used by your correspondent is not prepared from a good formula, and is too thin, or it would be white and harden properly. I use the following:— 1 oz. of benzine, $\frac{1}{2}$ oz. of gum dammar, and white oil-paint q.s. Dissolve the gum-dammar in the benzine and filter; then add a sufficient quantity of the paint to produce a good white. I have used this varnish for three years, and find it answers quite as well as that which is sold at the regular dealers, while the cost is less than a third of the price charged by them. The white paint may be procured at any artists' colourman's. A similar way is to take equal parts by weight of gum dammar and the finest zinc oxide; dissolve the former in twice its weight of benzol, and when dissolved, pour it into a mortar, where it is to be mixed with the zinc oxide. It must be well triturated, and if desired to be thin add benzol; if thicker, evaporate by exposure to the atmosphere (not heat, as benzol is very inflammable) for a short time in a saucer or flat dish. I have remounted specimens by soaking the sections in benzine and remounting as usual, but it is hardly worth the trouble unless the objects are valuable. V. A. L.

279.—Mounting Gizzards.—The gizzard may be obtained by holding the insect firmly with a pair of tweezers, and with the back or flat end of the handle of the knife *draw* the head from the body. The head brings with it the stomach, gizzard, and chief portion of the digestive organs. It is then separated from the other parts, cut open, soaked in potass, well washed, and mounted in glycerine, or first soaked in equal parts of glycerine, spirit, and water, and then mounted in glycerine jelly. It may be stained with carmine, or picro-carmine if desired. In the latter case, acidulate the jelly or glycerine with a few drops of formic or acetic acid. V. A. L.

280.—Mounting in Balsam.—Why does A. P. put his balsam mounts aside to harden with the clips on? I find the clip most useful when running benzo-balsam into a cell formed by beads or cards, as described in the *Enquirer* for July, but when this operation is over, I remove the clip, in most cases immediately, and

always before I put them away to harden. The benzole in which the balsam is dissolved, and with which I thin my balsam until it is fluid enough to run, by capillary attraction, between two glasses that are as nearly as possible in contact, speedily evaporates, and the thinner the balsam the greater and quicker the shrinkage. This loss has, of course, to be made good by supplying more balsam to the edge of the cover, and, with thick objects, I often have to "repeat the dose" two or three times within, say, an hour. By that time the mount is set sufficiently to be put away in a flat drawer, and there I let them stay weeks (not days) before the cleaning off is commenced. A. P. evidently uses a clip to press into position an object of appreciable thickness; he then surrounds it with balsam and puts it away clipped; after a "week or more" he has the clip still on, and the mount apparently right, as he left it. The balsam beyond the cover is somewhat hard, and this he proceeds to remove; the shrinkage under the cover then makes itself manifest in the shape of air-bubbles, which take the place of the suddenly-released benzole, the presence of which in the balsam would effectually prevent the hardening of the latter indefinitely. A. P. will avoid the demon air-bubbles if he will bear in mind when mounting that there is benzole in his balsam which *must escape*, and that it is better for him to admit this fact and "feed" his mount for the first hour or so than try to prevent it by clip-pressure. Let him try my method of forming a cell for objects of any thickness, in which case the removal of a clip does not cause the object to "spring," and for others, practically, of no thickness, let him use very limpid balsam, which will insinuate itself between the cover and the slide, in the centre of which, in a *tiny pool of benzole*, the object should be placed, the cover, centrally placed, lying gently on it. Of air-bubbles I now only *read*.

F. R. Brokenshire.

Queries.

All Questions and Answers should be clearly and concisely written on one side of the paper only, and every question or answer must bear the name and address of the writer. If this is written on the left-hand bottom corner, it will not be published, in which case initials or other signature should appear in the usual place. When more than one answer is sent by the same correspondent, each must be written on a separate piece of paper.

Correspondents, in sending us answers to questions, are desired to commence by quoting the number and title of the question as printed, before beginning their replies.

284.—Gentian, Violet, and Aniline Blue.—Will any reader

kindly oblige by explaining to me what are the differences between gentian, methyl violet, and aniline blue, and how best to prevent the stain diffusing through the mounting media? H.A.S.

285.—Tolu.—How is tolu used for micro mounting, and what are its advantages? L.

286.—Auerbach's Plexus, etc.—I should be very glad if any reader would kindly give me the method for preparing and showing Meissner and Auerbach's plexus in the stomach and intestine. HISTO.

287.—Preparing Sections of Teeth.—Will someone kindly give the easiest and best methods of preparing sections of teeth, especially to show the pulp and the odontoblasts in it, and also the lines of Retzius? ODONTO.

288.—Sharpey's Fibres.—I have often tried to prepare sections of these, but have failed. Will any reader kindly assist me? AMATEUR.

289.—Semilunes of Giannuzzi.—What is the best method of staining and mounting to exhibit the semilunes or crescents of Giannuzzi in the larger salivary glands, and which gland is the best? A.

290.—Pond-Life Collecting.—The enquirer would be glad of any help in the method of collecting pond-life, and of sorting and examining the same. BEGINNER.

291.—Sections of Equisetaceæ.—What is the best method of preparing sections of *Equisetaceæ*, to keep all the parts intact? BOTANIST.

292.—Methyl and Iodine Green.—What are the differences between the methyl and iodine green? I do not happen to have the formulæ by me, and any information will be gladly received as to the best method of staining, the properties of the same, and mounting. R. JACKSON.

293.—Staining Nuclei of Spirogyra.—What is the best method for staining the nuclei of *Spirogyra*? F. V.

294.—Diatoms.—What is the best instrument for picking out diatoms? C. S.

295.—Varnishes.—What are the best coloured varnishes for finishing purposes, and how are they prepared? W.

296.—Test Objects.—What are the best test objects for from 2-inch to 1-10th objectives, for defining power, flatness of field, and penetration? D. F.

Reviews.

Negative Making: Being a Treatise on the Practical Production of Negatives on Gelatine Plates. By Capt. W. de W. Abney, R.E., F.R.S. 12mo, pp. viii.—100. (London: Piper and Carter. 1887.) Price 1s.

We are glad to have the opportunity of noticing this, which is the first of a series of "Photographic Primers." The greater part of the information which it contains first appeared in a series of articles in the *Boy's Own Paper*, and furnishes a good deal of sound, practical advice on all those subjects respecting which a beginner is anxious to obtain information, and which, if he follows carefully, will doubtless give good results.

The Indispensable Bicyclist's Handbook: A Complete Cyclopædia on the subject of the Bicycle and its Construction. By Henry Sturmey. 8vo, pp. 383. (London: Iliffe and Son. 1887.) Price 2s. 6d.

The bicyclist will find much here to interest him. Every description of bicycle appears to be most minutely described, the various parts of different machines being compared, and in many cases illustrated by wood engravings. The addresses of the makers and prices of the different machines are also given. We notice that this book is now in its 18th thousand.

High-Class Cooking Recipes, as taught in the National Training School for Cookery, South Kensington, S.W. Prepared by Mrs. Charles Clarke, the Lady Superintendent. Second edition. Post 8vo, pp. vi. —220. (London: Wm. Clowes and Sons. 1887.) Price 3s.

This work contains a great number of very excellent high-class recipes for every conceivable variety of dish. Thus, we find many recipes under each of the following departments:—Soups, Dressed Fish, Curries and Indian Dishes, Entrees, Sauces, Vegetables and Salads, Savouries, Pastry, Omelets, Hot Puddings and Soufflées, Creams, Jellies, Ices, Cold Sweets, and Fancy Bread and Cakes. Each recipe is prefaced with a list of all the ingredients required, and the quantities of each. The recipes for Indian curries were collected last year in the Colonial and Indian Exhibition from a native of Madras.

Health Lectures for the People, delivered in Manchester 1886—7. 12mo, pp. 153. (Manchester and London: John Heywood. 1887.) Price 1s.

This is the tenth series of these very excellent lectures, and is concerned chiefly with the Causation of Disease, with a view especially to its prevention. It treats of some causes of Preventable Disease, Occupations in relation to Disease, Temperament in relation to Disease, Climate in the Treatment of Disease, the relation of Age to Disease, the Influence of Education on Health, Heredity in relation to Disease, and Diet in relation to Disease.

Fifty Years of British Art, as illustrated by the Pictures and Drawings in the Manchester Royal Jubilee Exhibition. By J. E. Hodgson, R.A. 8vo, pp. 100. (Manchester and London: John Heywood. 1887.) Price 1s.

The author tells us that "between the lines of the great Jubilee Art Exhibition of Manchester is to be read the history of the past fifty years; how the changing phases of modern thought mirrored themselves in the minds of men who had creative instincts, . . . producing art on the one side, and on the other subjugating wild nature to the axe and spade, tunnelling mountains, and bridging valleys, filling the whole wide world with its organised activity." He takes us through the Exhibition of Paintings, and has something pleasant to say about the merits or the demerits of the pictures and of the artists.

The Post-Office of Fifty Years Ago, containing a Reprint of Sir Rowland Hill's famous Pamphlet, dated 22nd February, 1837, propos-

ing Penny Postage, with fac-simile of the Original Sketch for the Postage Stamp, and other documents. 8vo, pp. 56—104. (London: Cassell and Co. 1887.) Price 1s,

We have here an interesting comparison of the rates of postage of letters at the time of her Majesty's accession (in which year Sir Rowland Hill published his celebrated pamphlet, which is reprinted in another part of this book) and the present time. Thus we find that a letter weighing under two ounces, which may now be sent from one end of the United Kingdom to the other for a penny half-penny, would then have cost 6s. 5d. to go from London to Manchester. A portrait of Sir Rowland Hill forms a frontispiece to the book.

D. C. Heath and Co., of Boston, U.S.A., have just published THE ENGLISH LANGUAGE: Its Grammar, History, and Literature. By Prof. J. M. D. Meiklejohn, of the University of St. Andrew's, Scotland. It is readable, omits insignificant details, and treats all salient features with a master's skill and with the utmost clearness and simplicity. It will prove invaluable to the teacher as a basis for his course of lectures, and to the student as a compact and reliable statement of all the essentials of the subject.

THE NATURALISTS' MONTHLY: a Journal for Nature-Lovers and Nature-Thinkers. Edited by Dr. J. W. Williams, M.A. (London: Walter Scott.) Price 6d. monthly.

At the moment of going to press we have received the first monthly part of this new journal, with which we are much pleased. We notice several interesting articles by well-known writers. The size, we may state, is that of *Nature*, and it consists of 20 pages in a neat coloured wrapper. We wish *The Naturalists' Monthly* the success it deserves.

Sale and Exchange Column.

[All Exchange Notices are inserted free; for Notices of Books or Scientific Instruments or Accessories offered for sale, a charge of 4d. for the first 12 words and 1d. for every succeeding 3 words will be made.]

For Sale or Exchange.—100 correctly-named and localised Rocks and Fossils.—J. B. Bessell, 8 Elm-Grove Road, Bristol.

Wanted, Foraminifera and Spicules in exchange for other objects.—J. W. Wilshaw, 455 Shoreham Street, Sheffield.

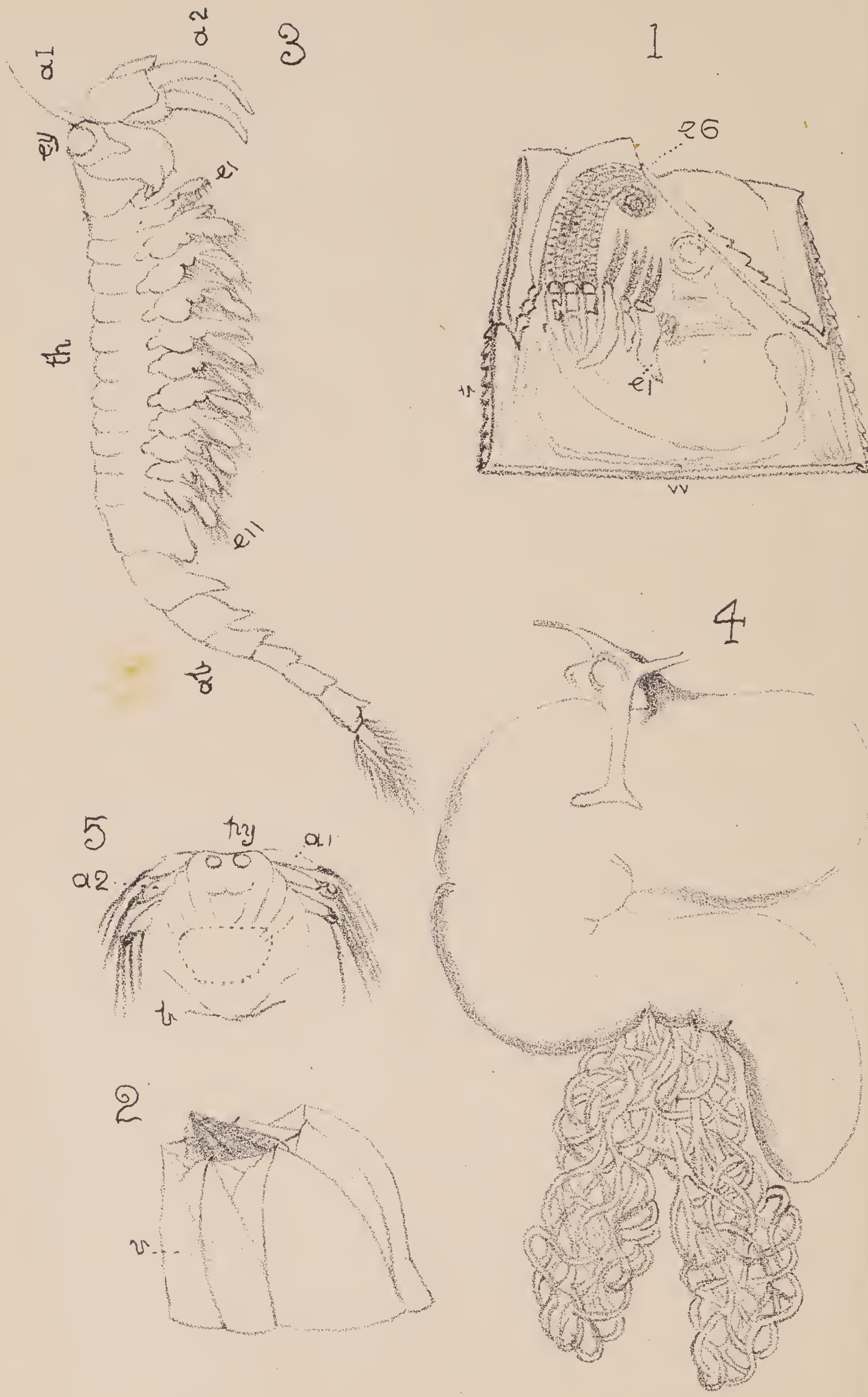
Interesting Microscope Slides, 6d. each, 5s. dozen. List, approval. Also, Requisites for Mounting.—"Micro.," 165 Hagley Road, Birmingham.

Microscopical Slips, Thin Covers, Media, Cements, etc., 33 kinds of Labels; samples, 2d. *Unmounted Objects* as fine Polariscopic Horn and Hoof Sections, Insects, Zoophytes, brilliant selected Show Objects from Exotic Lepidoptera, etc.—Chas. Watkins, King's Mill House, Painswick, Gloucestershire.

Natural History and Musical Works, Oolitic Fossil Coral, Micro Preparations, in exchange for named cabinet specimens of Diptera and Hymenoptera not in collection.—Chas. Watkins, Painswick, Gloucestershire.

Worked Flints, Paleolithic and Neolithic, in exchange for Fossils.—Apply to J. French, Felstead, Essex.

High-class Injections from Monkey, consisting of lip, tongue, liver, lung, spleen, finger. The six slides for 5s.—Henry Vial, Crediton, Devon.



Crustacea

The Scientific Enquirer.

OCTOBER, 1887.

Worms and Crustacea.

PLATE IX.

[CONCLUDED.]

BEFORE closing this series of papers on Worms and Crustacea, it has been thought desirable to add in a complete form an explanation of the plates. This is considered the more necessary as the plates did not always accompany the chapters to which they more directly referred. In explaining some of the figures in Plates II., III., IV., it is possible that a few of the reference letters may sometimes be omitted. These will be found in the explanations of other figures.

PLATE I.

Fig. 1.—The Common Earth-Worm :—*l'*, the anterior portion; *l''*, the posterior portion; *n*, the "clitellum," or "saddle"; *w*, end segments, broader and flatter than the rest of the body; *dv.*, the pseudhæmal vessel; *s.*, short hairs, or "setæ," projecting from the side of the worm.

„ 2.—Section of Earth-Worm :—*s.*, setæ; *o.*, outer cuticle; *hy.*, hypodermis; *q'*, circular bands of muscles beneath the hypodermis; *q''*, five thicker bands, which run the whole length of the body; *q'''*, muscular septa, extending towards the intestine; *r*, intestine; *dv.*, pseudhæmal vessel; *ns*, nerve-cord running along the floor of the body.

„ 3.—Head and portion of body of *Nereis virens*:—*hd'*, first segment of the body; *hd''*, second ditto; *a' a''*, first and second pairs of antennæ; *a* 3 —*a* 6, four pairs of antennæ on second segment of the body; *p.*, respiratory organs, called "paddles"; *s.*, setæ.

Fig. 4.—Shows the "paddles" and relative position of the internal parts in one section of the body:—*b.w.*, body-wall; *p.*, paddle, divided into—*d.p.*, dorsal portion, and *v.p.*, ventral portion; *s.s.*, bunches of bristle-like setæ; *r.*, intestine (marked *p.*, near the figure 4, in error on plate); *p.c.*, perivisceral cavity; *ns.*, a nerve-ganglion; *sg.*, segmental organs; *v.v.*, blood-vessels, running along the ventral surface; *dv.*, blood-vessels running along the back; *v.b.* and *ib.*, two branches of the ventral vessel; *co.*, capillary vessel.

„ 5.—Diagram representing the segmented body of *Nereis*:—*c.s.*, circulatory system; *d.s.*, digestive system.

Plate II.

Fig. 1.—Lobster, dorsal surface.

„ 2.—Lobster, ventral surface:—*ab.*, abdomen; *cth.*, cephalothorax, the outer shell of which is called the carapace; *sur.*, suture, or groove; *a′*, short antennæ; *a″*, long antennæ; *eye*, the eye.

„ 3.—Diagram showing—*lb.*, labrum, or upper lip; *ed.*, a line showing where the separation should be made in dividing a fresh specimen; *snc′*, sternal plate of the first pair of maxillæ; *b*, mandibles; *sn.b.*, sternal plate of mandibles. (For explanation of other letters, see explanation of Plate III. and Plate IV. Fig. 1.)

Plate III.

A.—*ca*, carapace, seen from above; *ro.*, rostrum or beak.

B.—Thorax, seen from above:—*e* 1—*e* 5, five pairs of walking-legs; *x*, terminating spike in some of the legs; *y*, jaw-like projection in front leg, but a spine only in fifth leg. *d*1—*d*3, three pairs of jaw-feet or maxillipeds; Nos. 2—9, cavities showing where the thoracic appendages have been removed; *g.*, gill-chamber.

C.—*f* 1—*f* 6, swimmerets of the first to the sixth rings; *h* 1, basal section of the same; *h* 2, *h* 3, end divisions of same; *ab* 1—*ab* 6, rings of the abdomen; *ab* 7, terminal piece, or telson.

E.—*h* 1, swimmeret; *h* 2, *h* 3, flattened lobes of the swimmeret; *tg.*, tergum; *sn.*, ventral beam, or sternum; *pr.*, pleuron.

Plate IV.

Fig. 1.—Cephalothorax from below:—Nos. 1—9, cavities showing where the thoracic appendages have been removed; *ac* 2 (No. 2), place of attachment of second pair of

maxillæ; *ad* 1—*ad* 3 (Nos. 1, 3, 4), place of attachment of the maxillipeds; *ae* 1—*ae* 5 (Nos. 5, 6, 7, 8, 9), place of attachment of the walking-legs; *t*., openings on the ventral sides of basal sections of antennæ, being the outlets of two large green glands.

Fig. 2.—*Squilla.*
,, 3.—*Oniscus.*
,, 4.—*Lucifer.*

PLATE V.

Fig. 1.—*Nebalia.*
,, 2.—Young of ditto.
,, 3—7.—Parts of Nebalia.
,, 8.—*Gammarus ornatus* (Edw.).
,, 9.—*Idotæa irrorata* (Say). The line shows the natural size of species.

PLATE VI.

Fig. 1.—The Hermit-Crab, *Eupagurus policaris*, as it appears when partly protruded from the shell in the act of walking.
,, 2.—The Hermit-Crab seen from ventral side when out of the shell. *rg*. is a hard ridge used for holding against the columella of the shell.
,, 3.—Crayfish, *Astacus fluviatilis.*
,, 4.—*Cancer irroratus*:—Female carrying eggs under the abdomen, which is for this reason extended behind, like the small part of the lobster.

PLATE VII.

Fig. 1.—Common Crab, dorsal view.
,, 2.—Ditto, ventral view.
,, 3.—The Fiddler Crab, *Gelasimus pugilator.*

PLATE VIII.

Fig. 1.—The Spider Crab, *Libinia canaliculata.*
,, 2.—The Oyster Crab, *Pinnotheres ostreum.*
,, 3.—*Limulus.*
,, 4.—Underside of ditto.
,, 5.—Cyclops:—*py*., eye; *a* 1, *a* 2, two pairs of antennæ; *eg*., egg-masses.
,, 6.—Young of Cyclops.
,, 7.—An older form.
,, 8.—Barnacle, *Balanus balanoides*:—*a*, Nauplius, young; *b*, young, about to attach itself: *c*, *d*, young barnacles, with shell formed and legs retracted; *e*, same, with legs extended, in the act of fishing.

PLATE IX.

Fig. 1.—*Balanus tintinnabulum.*
,, 2.—*Balanus Hameri.*
,, 3.—*Branchipus.*
,, 4.—*Lernea Branchialis.*
,, 5.—Young of ditto.

On Mounting in Canada Balsam by the Exposure Method.

BY G. H. BRYAN.

IT has been a matter of surprise to me that amongst the various methods of preparing microscopical slides, the so-called "exposure" method of mounting in Canada balsam or other gum-resins, in which the balsam is partially dried before the cover is finally placed on the slide, has received so little notice, that my object in writing this is to call attention to the advantages of this process for mounting almost all classes of objects, and also to describe a slight modification of it, by which means such arranged objects as sections in series, the various parts of an insect or other groups of objects may be mounted in balsam without difficulty.

The exposure method is due to Mr. A. C. Cole, by whom it is described in his papers on "The Methods of Microscopical Research," * and Mr. J. E. Ady gave in *Science Gossip* † a somewhat different version of the method, without, however, acknowledging that he learnt it from Messrs. Cole and Sons.

The great disadvantage of the ordinary way of mounting objects in soft balsam is that evaporation of the solvent (benzole or the volatile turpentine in common balsam) can only take place round the margin of the cover, so that the ultimate condition of such slides is that the object is floating in a sea of fluid balsam, surrounded by a wall of hardened balsam at the edges, and in clearing the slide we want to remove some of the latter without disturbing the former. Of course, the slide may be dried more thoroughly by being kept in a warm place, as over a hot-water cistern, but then some arrangement must be made by which the

* "Studies in Microscopical Science," vol. II.

† "Microscopical Technology," *Science Gossip*, Jan., 1884.

cover is prevented from slipping about, and a clip which squashes the object down *must not* be used, as the elasticity of the object will certainly cause the cover to "rise up in judgment" when the clip is removed. Again, the only way of mounting arranged objects is to get them in a pool of benzine under the cover; clip the latter on and run balsam under, when the objects are very likely to get disturbed in the process; or to fix them with gum, shellac, or some such medium, which generally necessitates the specimens being dried at some stage of the process, and cannot be used conveniently with the alcohol-clove oil process of clearing.

The following is a brief outline of the exposure method:—Breathe thoroughly on a glass slip, and on it drop three clean covers, which will thus adhere temporarily to the slip, or, if preferable, each may be let fall on the tiniest possible drop of water. On each cover let an object be arranged in a moderately convex drop of balsam, extending *to* but not *over* the edge of the cover. Then put the specimens away for the balsam to dry for at least twelve hours in one of the trays of a slide-cabinet, a *shallow* biscuit-tin with a tight-fitting lid, or other dust-proof box. The danger of dust falling on the cover during the exposure in such a biscuit-tin is *far* less than that of its doing so while the object is being arranged. Indeed, I believe that dust in slides can almost always be traced to other causes than the exposure, if effected in a proper box.

If dust should get in, we may remove it, as suggested by E. Ward,* by means of a brush dipped in benzine, if the brush is not *itself* dusty, which would make bad worse.

When the covers have been exposed long enough, they may be turned over on to warmed slides, but must not themselves be warmed first. The danger of large air-bubbles is diminished by placing or smearing a little fresh balsam on the slide, and this *must* be done if there is not enough balsam on the cover. If possible, the cover should be held in a pair of forceps and lowered *horizontally* over the slip, not on one side first. It is then less liable to tilt, and the fresh balsam is squeezed out symmetrically round the edge on pressing the cover down, and can mostly be at once taken off with a knife and the slide then cleaned with spirit, the part under the *middle* of the cover being filled with the exposed balsam, which is generally firm enough to keep from slipping. In any case, the small amount of soft balsam round the edge will soon dry after the rough scraping, thus avoiding the long waiting required before cleaning slides mounted in the usual way.

For mounting arranged objects, we may proceed as follows:—

* "On Mounting Opaque Objects in Balsam," *Journal of Microscopy.*

The cover being stuck by breathing to a slip as before, the objects are all neatly arranged on it in the layer of balsam, which should not be too thick. The cover must now be exposed till the balsam is nearly or quite *hard*—a week's exposure or longer may be requisite. The covers must be turned over on to a *cold* slip into a drop of soft balsam and pressed down, the objects being fixed in their places on the cover by the hardened balsam, which is undisturbed. Scrape off the superfluous soft balsam and put away to dry. The streaky appearance due to the two densities of balsam will soon disappear. In "Davies on Mounting," a method somewhat like this is just suggested, but it is not nearly so good as the present plan.

I have tried the above methods with great success for mounting whole insects, and parts of insects, under pressure. For preparing whole insects for mounting, I soak in potash, wash in water with a few drops of acetic acid, flatten out between two pieces of glass, which are tied together while the specimen is soaked for a further period in acidulated water, then in alcohol. Untie the glasses, float the insect on to a cover-glass and take it out, drain off superfluous alcohol, lay the cover on a slip, add a drop of clove oil, which will permeate the object, and the alcohol will mostly evaporate in half-an-hour or more. Most of the superfluous clove oil may then be drawn off with a pointed tube and the balsam applied.

Parts of insects may be lifted from the alcohol into a vessel containing clove oil, and afterwards taken out and laid out in the balsam on the cover. In this way I have mounted twelve parts of a honey bee neatly grouped on one cover and several other "type" slides. I think it will be found that these methods remove the chief difficulties of mounting in balsam, and especially of mounting arranged slides.

Short Papers and Notes.

A Garden Barometer.

ONE of the simplest of barometers is a spider's web. When there is a prospect of rain or wind, the spider shortens the filaments from which its web is suspended, and leaves things in this state as long as the weather is variable. If the insect elongates its threads, it is a sign of fine, calm weather, the duration of which may be judged of by the length to which the threads are let out. If the spider

remains inactive, it is a sign of rain; but if, on the contrary, it keeps at work during rain, the latter will not last long, and will be followed by fine weather. Other observations have taught that the spider makes changes in its web every twenty-four hours, and that if such changes are made in the evening, just before sunset, the night will be clear and beautiful.—*La Nature.*

Colours of Low-growing Wood Flowers.

No one can enter our English woods without being struck with the lovely way in which they are starred with the yellow of the primrose, the white of the anemone and strawberry, and the light blue of the dog violet. It will be noticed that the tints of these flowers seem positively to shine in the low herbage and among the semi-shade of the trees and bushes. After twice going through the descriptions of flowers growing in similar situations, given in Hooker's "Student's Flora of the British Islands," I find that nearly all our dwarf wood flowers are white, light yellow, and light blue. None appear to be red. Three are purple—one form of the Sweet Violet and the Ground Ivy *(Nepeta Glechoma)*, both of which are scented; and the bugle *(Ajuga reptans)*. If the white and yellow tints of flowers fertilised by night-moths are of service in guiding the moths to them, may not the like tints in low plants in thickets and woods be similarly advantageous to the plants by tending to secure fertilisation? The more lordly foxglove, the ragged robbin, and other higher-growing flowers erect above the low herbage and enjoying more light, are conspicuous enough, but how would a small flower of the colour of a foxglove attract attention when hid among the grass? The purple of the bugle I cannot account for. The ground ivy has a pungent scent. The purple of the sweet violet is certainly inconspicuous, but here the scent may be the attraction, or the habit of the plant in forming cleistogamous flowers may not secure its multiplication. Hence it may be questioned whether the white form of the sweet violet does not mark a gradual transition towards that colour. If the white forms are more conspicuous, and secure easier cross fertilisation, they may in time preponderate. Perhaps the existence of the sweet violet in the purple and in the white form may throw light on the origin of the general lightness of tint in dwarf wood subjects. The low flowers in dark places, which were lighter and made themselves best seen, would more readily secure fertilisation, and through natural selection would tend to have still paler tints. The change might be aided by the bleaching of flowers in shade. In this connection it may be noted that the wood anemone has a rare purple form—perhaps a

survival—and that *Anemone apennina* is light blue. The Potentillas, close allies of the strawberry, but mainly growing in the open, have as a rule yellow flowers; sometimes red ones. The various mountain primroses of this and other countries, and those that grow in meadows (like our own Bird's Eye Primrose, *Primula formosa*), have mostly reddish, lilac, or rosy flowers. The common primrose, when growing in exposed hedgebanks, has often reddish, lilac, or purple flowers. Its sports in cultivation are often white, so it may be progressing towards that tint in woods. The cowslip, which grows in meadows, has a deeper tinge of yellow than the oxlip, which grows in copses. The cowslip is also far darker than the primrose, and sometimes has a scarlet or orange-brown corolla—perhaps the germ of the dark rich polyanthus of our gardens. The primrose family may have originated in woods, and have been originally light, gradually darkening as the flowers multiplied in the open; or, which is more probable, the tribe originated in exposed situations, creeping by slow degrees into the woods, and bleaching as it went.

Staining Fat-Cells in the Fascia of a Calf's Neck.

After soaking for from half-an-hour to three hours in a half per cent. solution of osmic acid, the portion of the fascia is placed for fifteen minutes in a solution composed of carmine, $\frac{1}{2}$ dram; borax, 2 drams; water, 4 ounces. It is then quickly washed and mounted in glycerine, to every ounce of which add 2 drops of formic acid (Dr. Weisiger). V. A. L.

Sharpening Microtome Knives.

In using an oil-stone, the blade should be moved forward, edge foremost, care being taken not to raise the back of the knife from the stone, but to hold it lightly, the necessary friction being left to capillary attraction.

How a Feather Grows.

In the skin of a fowl where a feather is to appear, there is to be seen a little pit, and at the bottom of this a tiny mound or pyramid. Around the pyramid certain little grooves extend deeper at the base, seeming to radiate from one large groove at one side, all growing shallower, and finally disappearing at the top. The whole pyramid is covered with a skin composed of the same scales or flattened cells as those which cover the whole

body. In the ordinary process of growth, the new formations on the surface of the body throw off as effete matter the older portions of the skin, but here they are retained, and become so closely united to each other as to form a sort of horny coat, more or less strong (according to age) over the surface of the pyramid. As new cells grow at the base, they push up this little horny protuberance till it breaks at its thinnest point, which is opposite the large groove. Then, as new growths still push it forward and flatten it, it assumes the form of a feather, the ridge in the main furrow or groove being the shaft, while the side grooves form the separate barbs of the vein. When all this web of the feather is formed, the pyramid loses its grooves and becomes smooth. All parts are of equal thickness, and so hard as to break easily, but remain tubular, and form the quill, which is attached to what remains of the pyramid. The finger-nails, and even single hairs, are developed in the same way, and everyone who has injured a nail and lost it knows how long a process—some three or four months—is required to reproduce the missing finish to his digit.

The Colorado Potato-Beetle.

This destructive little insect, known scientifically as the *Doryphora decemlineata* (western ten-lined potato-bug), and popularly known as the Colorado potato-beetle, is said to have existed in the United States for upwards of a century. Its appearance as a destructive insect of any importance, however, was not noted until 1861, when it was found to be seriously ravaging Iowa, while in 1862 it was reported to be doing much injury to the crops in Kansas, and in 1866 to have done damage in a very small district to the amount of £200,000. At first, the insect seems to have fed on a species of wild potato in the Far West, but it soon attacked the cultivated species, and in six years is calculated to have travelled 360 miles eastwards. The perfect insect is about half-an-inch long, of a thick oval shape, and of a yellowish cream colour, with ten black lines—five on each side—running down the wing-covers. The head and thorax are of an orange-brown colour, and spotted and marked with black. The larvæ, which do the principal mischief, are at first reddish brown, which become paler and paler with increasing age. The head is black, and there is a ring of black on the first segment of the body and two rows of black spots on each side.

The eggs, according to Mr. Walsh, number from 700 to 1,200, and are deposited on the young leaves of the potato, attached by one end to the under side of them in clusters of a dozen or so. The *larvæ* hatch in a few days, and feed from seventeen to twenty days. Then they bury themselves in the earth, whence in ten or

twelve days they emerge perfect beetles. All these transformations are effected in about fifty days, so that the produce of a single pair (allowing three broods annually) might in one season amount to sixty millions. The last of the three broods remain under the earth during the winter and appear as perfect beetles in the spring.

The Slave-Making Instinct of Ants.

This remarkable instinct was first discovered in the *Formica* (*Polyergus*) *rufescens*, by Pierre Hüber, a better observer even than his celebrated father. This ant is absolutely dependent on its slaves. Without their aid the species would certainly become extinct in a single year. The workers, though most energetic and courageous in capturing slaves, do no other work. They are incapable of building their own nests or of feeding their own larvæ.

When the old nest is found inconvenient, and they have to migrate, it is the slaves which determine the migration, and actually carry their masters in their jaws. So utterly helpless are the masters that when Hüber shut up thirty of them without a slave, but with plenty of the food they liked best, and with their larvæ and pupæ to stimulate them to work, they did nothing. They would not even feed themselves, and many of them perished of hunger. Hüber then introduced a single slave (*Formica fusca*), and she instantly set to work, fed and saved the survivors, made some cells, tended the larvæ, and put all to rights. What can be more extraordinary than these well-ascertained facts? If we had not known of any other slave-making, it would have been hopeless to have speculated how so wonderful an instinct could have been perfected.—*Darwin's Origin of Species.*

Organisms in Ice.

A few years ago Mr. M. A. Verder made some microscopical investigations with regard to the purity of ice taken from canals and ponds, specimens being selected from the interior of blocks which appeared clear and transparent to the unassisted eye. On melting the ice and examining the water with a power of 900 diameters, bits of vegetable tissues and confervoid growths were recognisable at once, and upon allowing the water to settle and become warm at the ordinary temperature of a room occupied for living purposes, the sediment deposited was found to contain, after some hours, monads whose movements were easily discernible with a magnifying power of from 200 to 400 diameters. As the results of these investigations he is fully convinced that freezing does not free water from filth due to the presence of sewage, or decaying vegetable matter.

Glue, Paste, and Mucilage.

Lehner publishes the following formula for making a liquid paste or glue from starch and acid:—Place 5 lbs. of potato starch in 6 lbs. (3 quarts of water, and add ¼ lb. of pure nitric acid. Keep it in a warm place, stirring frequently for forty-eight hours. Then boil the mixture until it forms a thick and translucent substance. Dilute the water if necessary, and filter through a thick cloth. At the same time another paste is made from sugar and gum arabic. Dissolve 5 lbs. gum arabic and 1 lb. sugar in 5 lbs. of water, and add 1 oz. of nitric acid and heat to boiling. Then mix the above with the starch paste. The resultant paste is liquid, does not mould, and dries on paper with a gloss. It is useful for labels, wrappers, and fine bookbinder's use. Dry pocket glue is made from twelve parts of glue and five parts of sugar. The glue is boiled until entirely dissolved, the sugar dissolved in the hot glue, and the mass evaporated until it hardens on cooling. The hard substance dissolves rapidly in lukewarm water, and is an excellent glue for use on paper.

Electrical Insects.

The following interesting description is quoted from Kirby and Spence's Entomology:—"You are well acquainted with the history and properties of the *Raia Torpedo* and *Gymnotus electricus;* but, I dare aver, have no idea that any *insect* possesses their extraordinary powers. Yet, I can assure you, upon good authority, that *Reduvius serratus*, commonly known in the West Indies by the name of the *wheel bug*, can, like them, communicate an electric shock to the person whose flesh it touches. The late Major-General Davies, of the Royal Artillery, well known as a most accurate observer of nature, and an indefatigable collector of her treasures, as well as a most admirable painter of them, once informed me that, when abroad, having taken up this animal and placed it upon his hand, it gave him a considerable shock, as if from an electric jar, with its legs, which he felt as high as his shoulders; and, dropping the creature, he observed six marks upon his hand where the six feet had stood." Two similar instances of effects on the human system resembling electric shocks, produced by insects, have been communicated to the Entomological Society by Mr. Yarrell; one, mentioned in a letter from Lady de Grey, of Gorby, in which the shock was caused by a beetle, one of the common *Elateridæ*, and extending from the hand to the elbow on suddenly touching the insect; the other caused by a large hairy lepidopterous caterpillar, picked up in South America by Captain Blakeney, R.N., who felt on touching it a sensation

extending up his arm, similar to an electric shock, of such force that he lost the use of his arm for a time, and his life was even considered in danger by his medical attendant.

Instinct of Insects and Birds.

Let us examine the marvellous instinct of the solitary wasp in providing for the worm that will issue from her egg after her own death. She brings grubs—food that, as a wasp, she never tasted—and deposits them over the egg, ready for the larva she will never see. The life history of every insect exhibits instincts of this perplexing description. Look at the instinctive character of bees in their far-sighted provisions for the future. Witness the caterpillar, how at the proper time it selects a suitable situation and spins for itself a silken cocoon. Marvellous instincts are met with outside the insect world; every little bird is its own skilful accoucheur. We once observed the self-delivery of the chicken. The prison wall is not burst in pieces by struggles. By a regular series of strokes the shell is cut in two—chipped round in a perfect circle some distance from the large end. The bird has a special instrument for this work—a hard, sharp horn on the top of the upper mandible, which, being required for no other purpose, disappears in a few days. Obviously each individual bird no more acquires the art of breaking its way out than it furnishes itself with the little pick-hammer used in the operation; and it is quite clear that a bird could have never escaped from the egg without this instinct. How were eggs hatched before birds had acquired the instinct to sit upon them? A fowl that never before willingly shared a crumb with a companion will now starve herself to feed her chickens, which she calls by a language she never before used—may have never heard—but which they are born to understand.

The Stinging Nettle.

We may find a fair starting-point for our researches into the movements and internal activities of living beings in a simple study of the actions which the microscope reveals to us as occurring within the tissues of well-known plants. For instance, there is no structure which makes a more pronounced appeal to us in the way of painful, practical botany than the stinging-hair of a nettle. A nettle-hair is an appendage of the nettle-leaf, but, unlike the ordinary hairs which we see coating the surface of the many leaves, it possesses at its base a kind of gland or secreting structure, which manufactures the irritating fluid that is practically the nettle's poison. The point of this hair is extremely delicate.

The slightest touch breaks the point, and the poison fluid with which the hair is charged at once flows into the skin, and produces there the characteristic pain and after-effects. Thus, a nettle stings as a serpent stings; both possess an apparatus consisting of a poison-gland and a fang—the latter being the "hair" in the nettle and a hollow tooth in the snake. But the living nettle-hair has a more curious aspect and history than those included in the recital of its offensive powers. When placed under a sufficiently high power of the microscope, the nettle-hair, which, like the nettle itself, might be regarded as an inert structure exhibiting no sign of life or activity, is seen to be a perfect centre of curious and interesting movements. The contents of the hollow nettle-hair—or, more strictly speaking, its lining—are seen to exist in a state of continual motion. There are waves of contraction which roll like the billows of the ocean along the whole length of the hair; and there are minor streams of granules which hurry here and there with varying speed through the substance of its interior. Main currents may be traced around the margin of the structure, and that there are many minor currents hidden from the highest powers of our best microscopes no one may doubt. Thus, the nettle-hair is a very centre of active movements and of an incessant circulation of its particles and fluid, such as we could not dream existed in the apparently stable and inert plant-form.

Composition of a Ton of Coals.

There is more in a heap of coals than most persons are aware of. Besides gas, a ton of gas-coal will yield 1,500 pounds of coke and 20 gallons of coal-tar. Destructive distillation of the coal-tar gives 69·6 pounds of pitch, 17 pounds of creosote, 14 pounds of heavy oils, 9·5 pounds of naphtha yellow, 6·3 pounds of naphthaline, 4·75 pounds of naphthol, 2·25 pounds of alizarine, 2·4 pounds of solvent naphtha, 1·5 pounds of phenol, 1·1 pounds of aniline, 0·77 pound of toluidine, 0·46 pound of anthracine, and 0·9 pound of toluene. From the last-named substance is obtained the product known as saccharine, which is said to be 230 times as sweet as the best cane sugar.

Wasps.

A correspondent, writing to the *Journal of Horticulture*, says: "The easiest way to destroy wasps is to roll a piece of rag together about the size of one's finger, saturate it with turpentine, place the rag in the hole leading to the nest, and cover it with soil

to keep the air out. This should be done about six o'clock at night. Nothing further is required, but if the nest be dug out next day every wasp will be found dead. They can be destroyed in this way in all places where the air can be excluded.

A White Crow.

A crow with perfectly white plumage has been found in the rookery of Crossley Cote, Northallerton, the residence of Mr. E. M. Edwards, J.P.

Answers to Queries.

255.—Micro-Polariscope.—The advantage of rotating both analyser and polariser is that, although the relative positions of their planes of polarisation are unchanged by simultaneously turning both, yet their positions relative to the object are changed, a result also obtainable with a rotating stage. G. H. BRYAN.

284.—Gentian Violet and Aniline Blue.—Gentian violet is mostly used for staining *T. Bacilli.* Do not leave the sections too long in either the alcohol or the oil of cloves, both of which reagents dissolve out the staining fluid very rapidly. I should think the enquirer means methyl blue and not *aniline blue* (*black*). The former is a contrast-stain, and is also a very good stain for muscular fibre. It is made as follows:—Methyl blue, 1 part; anhydrous alcohol, 15 parts; distilled water, 35 parts. When used, dilute with five times its volume of water. Mount in glycerine. Farrant's methyl violet gives certain normal tissues a double stain, especially waxy degeneration. To mount wash the sections in very dilute acetic acid, and mount in Farrant or glycerine, or wash in alcohol. Render transparent in clove oil, and then mount in dammar or Canada balsam. See Vol. V. *Journal of Microscopy and Natural Science.* V. A. L.

285.—Tolu.—Tolu has a higher index of refraction than styrax. For mounting it should be dissolved in alcohol or chloroform (preferably the latter), and then well filtered and evaporated to the required consistency. The colour is a disadvantage, but this does not seriously affect thin mounts like diatoms. It may be used to imbed objects, and objects can be better and more easily cut when they have been previously treated with tolu instead of chloroform. After the object has been hardened in alcohol, it is placed directly into tolu for twenty-four hours (or less for small

objects), and transferred from it to the paraffin bath, in which it is also kept for twenty-four hours. The ordinary gum benzoin (or benjamin) is quite as good as styrax, if not better, but neither is so good as tolu. The gum benzoin should be prepared as directed for tolu. I find the great objection to tolu is the formation of crystals. This I account for, by supposing that either tolu is variable in its composition, or the way of preparation and using it prevents crystallisation. The balsam, as a solvent, prevents this. Tolu becomes colourless with exposure to the light and with age, and is simpler to prepare than styrax, it being only necessary to dissolve 1 part of the balsam of tolu in 2 or 3 parts of benzole or chloroform. Filter and use. The easiest way to get rid of the acids, whose crystals are so objectionable, is to use disulphide of carbon, water being objectionable on account of the difficulty in getting rid of it by evaporation. V. A. L.

286.—Auerbach's Plexus, etc.—I think "Histo." will find the following methods, given in Stirling's "Text-Book of Practical Histology," good and reliable for demonstrating Auerbach's plexus, and the *plexus myentericus* of Meissner in the intestine:—

(*a*) "Wash out a loop of perfectly fresh small intestine of a rabbit, and distend it with the juice of a fresh lemon; ligature both ends of the gut, and place it, still distended, in lemon juice for from five to seven minutes. Open the ligatures and wash it thoroughly in water, and fill it with a 2 per cent. gold chloride solution; ligature the gut as before, and suspend it for half-an-hour in a 1 per cent. solution. Wash it thoroughly, and transfer it to a 24 per cent. dilution of formic acid to reduce the gold. The preparation must be kept in the dark. After reduction, it has a beautiful, rich, reddish-brown colour. Wash it thoroughly, and keep it in a preservative fluid. With forceps it is easy to peel off strips of the outer muscular layer, to which Auerbach's plexus adheres. Mount in glycerine. The separation takes place more easily after maceration for a week in the preservative fluid. This is the best method."

(*b*) "Another method is to use dilute alcohol, as the distending and softening medium, for forty-eight hours: then to peel off the outer muscular coat, as directed above. Stain it with logwood, and mount in glycerine. This gives fairly good results."

(*c*) "One-twentieth per cent. acetic acid may be used in the same way to fill the gut and to macerate it for thirty hours. After maceration and washing, it is well to steep the gut for a short time in five per cent. solution of sodic bicarbonate, to get rid of the acid. Peel off the muscular coat as before, stain it with logwood, and mount in glycerine."

Though the above methods refer more especially to the

demonstration of Auerbach's plexus, the plexus of Meissner may be prepared in a similar manner.

F. R. Rowley, Leicester.

287.—Preparing Sections of Teeth and Bone.—Use only fresh teeth, etc., and grind down, first one side and then the other of the tooth or sawn section of bone on a dentist's lathe with a set of emery wheels. Then use the palmar surface of the index finger or thumb to press the section against the stone (a piece of cork protects the skin). A tooth can be thus made ready to mount in thirty minutes after its removal from the jaw. Perfect longitudinal sections of teeth can be made in this way which are so thin that they will bend under their own weight. Another way is to place the teeth in a very fluid and not too warm mixture of 10 parts of colophonium (rosin) and 1 part ordinary wax, the latter serving to reduce the brittleness of the former. It is quite transparent. The objects should be well covered with the mixture and lifted out with a pair of forceps. The grinding is done on a glass plate with emery powder of various degrees of fineness. When one side of the section is smooth, it is attached to the slide, and the other side similarly ground down and polished. It should then be washed with oil of turpentine and (moistened with the oil) left under a bell-glass to clear and render transparent. The remainder of the imbedding material is best removed with chloroform. If the section is damaged and likely not to hold together, it can be mounted without dissolving the colophonium, which when pure is little inferior to Canada Balsam. In this case the slide should be warmed very gently, or some drops of chloroform run over it before the cover-glass is put on.

The Jaws of a well-injected animal are placed for a few days in 50 per cent. of alcohol, then into absolute alcohol for about two weeks; then with a fine sharp file cut away the bone from both sides of the jaw where the section is desired until, by holding to the light, the pulps of the teeth are visible, carefully keeping the piece and the file wet with alcohol during the operation. Thoroughly wash the piece with a soft brush in alcohol and place in clove-oil for a few hours or until clear. Then transfer to a very thin solution of balsam in benzole, gradually thickening the solution from day to day by adding pure balsam until the tissues are thoroughly permeated. This is an important part of the process, and should not be hurried. Now place the piece in a shallow dish, and add pure balsam enough to cover it and evaporate to hardness, being careful not to raise the heat above 110 deg. F., when the balsam will hold the soft parts in position. Now continue the grinding, and whilst this is being done use water as a lubricant for this part of the work. When the section is ready,

dissolve out the balsam with benzole, place in absolute alcohol for a day, clear again in clove-oil, and mount. The sections are necessarily somewhat thick, for the reason that the different parts which it is desired to show in the section seldom lie in the same plane. Consequently, they are best mounted in a cell-ground into the slide, which allows the cover-glass to be brought down close. Dammar will be found the best medium to mount in. V. A. L.

287.—Preparing Sections of Teeth.—1.—Saw a piece off a bone or tooth, rub it flat on an engineer's file, polish the flat surface on a fine hone, Water-of-Ayr stone being preferable.

2.—Fasten the section on to a piece of plate glass, 1 inch square, with a cement made by melting six parts of button "lac" with one part Venice turpentine.

3.—File the section down moderately thin, and then reduce further on the Water-of-Ayr stone, examining from time to time with the microscope.

4.—Soak the section off with strong methylated spirit; wash thoroughly in clean spirit, and dry between tissue paper.

5.—Make a thin solution of white shellac in methylated spirit, filter, and keep in stoppered bottle. The section is to be dipped in this solution, drained, and laid on a cold plate under a bell-glass. In about half-an-hour it will be dry.

6.—Mount in cold balsam and benzole in preference to hard balsam, in order to avoid heating the section, as that would give it a tendency to curl; but as the melting point of the shellac is higher than balsam, the latter may be used if thought desirable (J. E. Ady's method). V. A. L.

288.—Sharpey's Fibres.—(*a*) Decalcify a piece of human parietal bone (which is the best) in dilute hydrochloric acid. Make vertical sections and place one on a slide. With needles tear off the peripheric lamellæ, using a dissecting microscope. Some of the fibres will thus be torn from their sockets, and will project as fine processes from the lamellæ. In a preparation showing the lamellæ, prepared by pulling off a thin layer of the peripheric lamellæ from a bone softened in dilute hydrochloric acid and denuded of its periosteum. Examine in water. If wanted to be preserved, it must be placed for twenty-four hours in a $\frac{1}{2}$ per cent. osmic acid and mount in Farrant.

(*b*) Digestion of a piece of bone with artificial pancreatic juice (see *Journal of Microscopy and Natural Science*, Vol. V., p. 237), previously softened with dilute chromic acid, enables one to isolate the fibres of which the lamellæ are composed (Birch), and preserve in 10 per cent. sodic chloride. The fibres are directed towards the observer. No Sharpey's fibres, such as are described above, are found within the Haversian systems. They are found

within the peripheric and intermediary bundles. The flat bones of the skull are the best, but I have found them in sections of the long bones. V. A. L.

291.—Sections of Equisetaceæ.—Cut transverse sections from a mature internode of an upright aerial stem; mount some in glycerine, others in Schulze's solution. Cut rather thick transverse sections through the nodal region. It will be best to select one which bears no fully developed lateral branches. Keep them all in their right order of succession, mount, and compare under low power. This does not quite answer the question, but will probably help the enquirer. V. A. L.

292.—Methyl and Iodine Green.—The former is a lighter green than the iodine, and is used in the same manner. A 2 per cent. solution is usually strong enough. It has a peculiar affinity for the heads of spermatozoa. Dehydrate rapidly in absolute alcohol and clear in cedar-wood oil. I prefer specimens mounted in glycerine. Methyl green has a peculiar affinity for amyloid substance, and is a very delicate test for it. It also colours hyaline casts ultramarine blue, as in the section of a kidney the healthy tissue would appear green, hyaline casts blue, and amyloid spots violet. It has a peculiar affinity for nuclei in a fresh state. It is a pure nuclear stain, and is an admirable fixing agent. I find it of great use in the study of the histology of the principal nerves of insect larvæ. Methyl-green is obtained by treating methyl-violet with methyl-nitrate instead of methyl-iodide, as in the manufacture of iodine green. Specimens stained with iodine green are washed out in water and mounted in glycerine or dehydrated in absolute alcohol, and passed through clove-oil or aniseed into balsam or dammar. *The stain is not destroyed by immersion in alcohol for days.* Chromic-acid specimens stain well, and it is extremely useful for ganglion cells, axis cylinders, etc. See *Journal Postal Microscopical Society*, 1886. V. A. L.

293.—Staining Nuclei of Spirogyra.—I should think methyl green would be one of the best stains, especially if fresh. I have found most of the aniline dyes (various strengths in different cases) show the nuclei well. I would recommend the enquirer to read Vol. V. of the *Journal of Microscopy and Natural Science*, where he will find the special stains given. V. A. L.

294.—Diatoms.—For selecting a diatom, I prefer a bristle or good cat's whisker, either of which I find superior to anything else I have tried. V. A. L.

295.—Varnishes.—The choice of coloured varnishes for finishing are so various that the choice had better be left to the enquirer. Good finishing varnishes are made by adding dry

colours to dammar varnish or balsam, grinding and filtering. A good black may be made of asphalt and of Japan gold-size, zinc-white, benzole, etc. V. A. L.

Queries.

All Questions and Answers should be clearly and concisely written on one side of the paper only, and every question or answer must bear the name and address of the writer. If this is written on the left-hand bottom corner, it will not be published, in which case initials or other signature should appear in the usual place. When more than one answer is sent by the same correspondent, each must be written on a separate piece of paper.

Correspondents, in sending us answers to questions, are desired to commence by quoting the number and title of the question as printed, before beginning their replies.

297.—Hydroidæ.—How may the *Hydroida* be successfully mounted so as to show the tentacles expanded as well as the true characters of the animal? J. W. G.

298.—Snail.—How may a snail be best killed so as to make an examination of its eyes? J. W. G.

299.—Iron.—Is there any known means of preventing bright iron and steel from rusting when exposed to the occasional fumes of gases, such as chlorine and carbonic acid? M. B.

300.—Photography.—What is the best cheap work on "Dry-Plate Photography" to enable an amateur to succeed in the art? M. B.

301.—Indian Yellow.—Can anyone give the composition or mode of preparation of a pigment called Indian yellow? I. N. D.

302.—Coloured Confectionery.—What are the chief yellow colours, other than turmeric and gamboge, used in colouring confectionery? I. N. D.

303.—Magenta.—Is magenta or ros-aniline or fuschine poisonous? On what data do you base your answer? M. A. G.

304.—Palmyra.—What is palmyra wood? Is it from a palm or fern? Is it very hard and heavy with jet-black fibro-vascular bundles, the parenchyma being of a quite light brown? PALM.

305.—Campanularia volubilis.—Will any reader kindly tell me how to mount *Campanularia volubilis?* Also, how to mount insects' eggs? E. B. P.

306.—Spines of Echinus.—What is the best way of cutting and grinding sections of these small objects for the microscope? G. H. B.

Correspondence.

To the Editor of the "Scientific Enquirer."

SIR,—

In the "Journal of the Royal Microscopical Society" of October last, reference is made, on p. 903, to Dr. Morris's sulphur and arsenic combination giving the best results as a mounting medium for diatoms; can any of your readers tell me the preparation and manipulation required for its use, giving full details? Have any tried the arsenious acid and antimony bromide compound given in the same number?

I remain, yours faithfully, J. E.

Sale and Exchange Column.

[All Exchange Notices are inserted free; for Notices of Books or Scientific Instruments or Accessories offered for sale, a charge of 4d. for the first 12 words and 1d. for every succeeding 3 words will be made.]

The Scientific Enquirer.

NOVEMBER, 1887.

First Snow and Last Leaf.

THE unerring thermometer warns us that we have arrived at the period of decaying plant life which in these latitudes precedes and portends the advent of winter. Some dusky visitor from a land where nature is always verdant might well give way to an ecstasy of wonder were such a stranger to the hues of our autumnal landscape suddenly confronted with an English woodland in its October livery. Linnæus, according to the current story, dropped upon his knees, and, as a good Christian and a devout naturalist, thanked heaven for a sight of those great natural fields of cloth of gold with which the gorse now and again clothes our wastes and commons. Not less keen would be the delight, and none less genuine the surprise to unaccustomed eyes, at the blaze of colours which have been lately decking our country sides and lighting up coppice and hanger, shrubbery and grove, like some gay final transformation-scene to close the long and pleasant pageantry of summer. Nature, in this concession to our Northern woodlands, is very kind. It would be a sad exit for the bright season if it went out wrapped in the sere and sombre dress of the winter which has now at last come. But as it is, dwellers in temperate climates, and especially in the wooded districts of fair and fertile England, have in their October foliage an episode of varied harmonies only to be excelled in Canada or America. There is little really to compete with it in the colours of tropical foliage, for under equatorial suns, though the seasons change, there is no rise or fall of temperature sufficient to arrest the vegetable life of a whole country, and to bring about those delicate chemical disturbances of chlorophyll to which our own botanical kingdom is liable. The endless bamboo thickets of India and Burma wither after a flowering season, and mighty ranges of upland plateau become all

yellow and brown from horizon to horizon; but here the autumnal colour has been lovely, whichever way the eye turned. The forest trees, also, in lands where seasons might be divided with strict accuracy into a dry summer and a wet one, don new habiliments when the old are passed away, but with no sort of settled unanimity about their change. That wealth of colouring which comes before our own Northern winter is the prerogative of Western Europe and of America; the "gorgeous East" must be content with the individual splendour of its forest-trees and jungle-blossoms. A wonderful blush of colour, no doubt, passes upon the forest-thickets of the Himalayas when the rhododendrons are out, and, again, the *ensemble* is certainly splendid when, under the forest roof, countless white orchids are revelling in the warmth of an Indian April. Such vegetable glories, too, of the East as the fiery crimson of a silk-cotton tree in full blossom, or knots of cactus at their best, when the pale sulphur blossoms, jutting from every oval leaf, look like a strange golden fruit upon a leaden-coloured slab—these are notable. But as regards foliage the great forests of hot climates are for the most part uniform in tone, and deciduous by gradual and inappreciable change.

The cause of the change that thus dissolves the green from nearly all our familiar trees, revolutionising both tint and texture of leaves some time before they are ready to fall, is a subject of many learned opinions, based on ingenious though contradictory experiments. One patient observer tells us the brown colour succeeding to the verdure of summer is due to a preponderance during this "season of mists and mellow fruitfulness" of the rays of light, called by Herschel parathermic, strongly manifested in the red side of the spectrum. A slight tinge of green is found to stop these reactionary rays, and it is in obedience to such a theory that the great winter conservatories of Kew and elsewhere are fitted with glass to which oxide of copper has lent a faint suspicion of the required protective medium. Macaire, Prinsep, and Ellis thought the red and yellow tints of autumnal scenery were due to the production of an acid; but neither the ingenious suggestions of Sir John Lubbock, nor those of many other erudite botanists, have quite taken us to the root of the matter. We know, however, for certain that it is an instinct of leaves to be green. In this state their delicate yet mighty task of purifying the earth's atmosphere, and regulating absorption and condensation of vapour, besides a first duty of acting as the thin myriad lungs to each parent stem, is best accomplished. That rapid vegetable principle whose transformation flushes our Southern shires with red and gold the botanists have agreed amongst themselves to call chlorophyll. It is healthy chlorophyll which makes

all the difference between the forest shades and the sickly yellow of vegetation shut out from light or air; and, inasmuch as the strong light of returning summer vitalises this fluid, it has been argued that the waning potency of autumnal light may be the cause of subsequent failure and picturesque decomposition. So intimate is the connection between light and this healthy colour that French beans started into growth in darkness have turned to their ordinary greenness in one hour's hot sunshine, while etiolated plants have recovered after twenty-four hours of diffused daylight reaching them under water. Ellis gives a curious instance of the rapid action of rays upon this delicate and susceptible pigment. He writes that in North America the operation of light in colouring the leaves of plants is sometimes exhibited on a great scale and in a very striking manner. Over the vast forests of that country clouds sometimes spread, and continue for many days, so as almost entirely to intercept the light of the sun. In one instance, just about the period of vernation, the sun had not shone for twenty days, during which time the leaves of the trees had reached nearly their full size, but were of a pale or whitish colour. One afternoon the sun shone forth in full brightness, and the colour of the leaves changed so fast that by the middle of the afternoon the whole forest for many miles in length exhibited its usual summer dress. All this is urged in favour of the arguments of those who maintain, not without some hesitation, that the loss of a clear atmosphere with bright sunshine is at the root of the change overshadowing our woodlands just now.

It is certain that the actual fall of the leaf, to which this gorgeous colouring of the autumn woods has been due, is a natural and orderly process. Nature is not taken by surprise in such matters as this. She is cognisant of future frost and north winds. When the new bud unfolds in spring, it is already marked with the presage of destruction. A thin black ring, in some cases more obvious than in others, encircles the base of its stalk, and even while the leaf expands and vigorously exerts its functions of vegetable respiration, this cincture deepens downwards. Cells containing crystals are developed all along its surface, and as the season advances the connection between stem and frond becomes more and more superficial, until the first frost of winter—the first north-easter with pelting rain-storms behind it—scatters the used-up foliage, and exposes at each ready-healed scar the embryo buds of another season.

But people shivering with the first winter winds may fairly be excused at the present time from any close interest as to whether our fading autumn landscapes, with their infinite diversity of colouring, have owed much or all of their charm to chlorophyll or

chromule. An unphilosophical enjoyment of the painted aisles of forest and plantation is possible which takes no heed of whether all these gaudy relics of the summer time have died upwards or downwards. What the ordinary observer has seen and appreciated until the snow came is the infinite variety and harmony which spread itself before him in a country walk or in a journey from shire to shire. It is a beauty as effective in the aggregate as in detail. The smallest filament he can pull from a wayside bramble has of late appeared a mosaic of colour—an enamel of crimson on black, or of maroon upon yellow—complete in itself and worth a whole lecture on the quiet chemistry of the hedgerow. Anyone recently looking down on many a mile of oak woodlands clothing the Surrey hills or undulating wolds of Kent has beheld one vast expanse of golden foliage shining in the sunshine like the ripest field of red wheat that ever fell before a scythe. The elm trees lining roadsides and mapping out fields were, a little later on, masses of bright ruddy leafage more strikingly effective than the delicate drapery of green spangles they wore six months back; planes, maples, and poplars were all for longer or shorter periods equally vivid wherever the sun caught them; and, in midwood, pale-stemmed birches were delicately graceful in their thin amber-coloured mantles; while whole hillsides of deciduous spruces wore much the same shining yellow livery as the long golden and umber bracken at their feet. In the littered orchards and gardens of October an equal richness, and even more variety, of tone was to be seen for some weeks of this bygone season.

Why should not a little more attention be paid to the tints of bushes and trees? Utility and beauty might be combined, and when our pleasaunces are unavoidably bare of summer flowers, we might still put back for a space the days of hueless landscapes by a little judicious arrangement with nature. A liberal-minded possessor of greensward and shrubbery could do worse to-day than take an easy lesson from any convenient orchard or nursery-garden. He might there observe that the pear, for instance, is a species of infinite capacity in this direction. In the spring it is a cloud of dainty blossoms that would not need to blush by comparison with the choice and supercilious denizens of our conservatories. All through the summer its foliage, in whatever variety, is as glossy and close as could be desired, while in early autumn the ruddy, seductive fruit adds another point of colour to the pear tree's excellences, and afterwards each species in the long list of which the pomologist knows dies in some new phase of loveliness. The suggestion of a new art in gardening is strong on every hand just now, and if we do not accept it for future use we

fairly deserve to go bare and colourless into the winter months a whole fortnight before the calendar inexorably insists upon bitter blasts and naked landscapes.—*From* "*The Daily Telegraph.*"

Short Papers and Notes.

A Monograph on Earwigs.

By M. A. Henty.

THIS year earwigs have been very much to the fore in the insect world, and many houses in the south of Hertfordshire have been rendered very unpleasant from them, many of the inhabitants finding over sixty in their rooms at night (having taken possession of their beds and other inconvenient places), besides catching many hundreds in the daytime.

The earwig is an insect that most people have a great antipathy to, partly from an erroneous fancy that it is fond of creeping into their ears and partly because it does sometimes pinch. The name of this insect is rather a disputed point. Some think it should be called earwing, not earwig, from the wing of the insect having a great resemblance to the human ear. Many people do not know they possess wings. If you happen to mention before a small company of people that earwigs are seldom seen on the wing, someone is sure to remark, "Wings! I did not know earwigs had wings." The wings, really, are large, beautiful, and delicate, and after flight the insect takes great pains to tuck them up neatly away under the elytra. This requires care, and they turn their tails over their backs, and use their forceps or pincers for this purpose. This, really, is the primary use of the pincers, but they are used in self-defence, and they can give a sharp nip with them if handled roughly. Though earwigs have few friends, their life-history is both a study and a poem. The mother earwig is one of the few insects that looks after her own young. Some may exclaim, wasps, bees, and ants do, but it is the workers, not the *mothers*, who do this. The earwig shows an affectionate interest in them, as a hen does over her chickens. De Geer has made many observations about them, and states this also, that she deposits her eggs in a damp, moist place, and if these conditions fail she removes her eggs to a different place. Mr. Spence also states that, turning over a stone by accident, he found an earwig sitting on a cluster of young ones. So, perhaps, people, after reading these facts, will not for the future consider the poor little earwig quite the monster it is generally supposed to be.

An Optical Illusion.

In *Comptes Rendus*, M. Charpentier describes that, fixing his eyes immovably on a sky illuminated by a uniform white light, and moving two fingers of his right hand rapidly and alternately backwards and forwards before them, he saw, after a minute, a remarkable change in the uniform aspect of the heavens. There appeared on a white ground a mosaic composed of rather deep violet-purple hexagons, separated from each other by white lines, and forming a very regular design. The oscillations of the fingers should be from 300 to 400 per minute. He thinks that these hexagons are due to the cones in the fovea and in the yellow spot, and that the white lines are due to their intervals.

The Nettle-Leaved Bell-Flower.

(*Campanula Trachelium.*)

We can well remember the delight we ourselves felt on first coming across this beautiful flower, and those of our readers who are familiar with it will fully share our feelings. It appears to be more freely met with in the northern districts of Britain than in the south, though it is pretty commonly distributed throughout the country. The nettle-leaved bell-flower should be looked for in woods, though we have often seen it in sheltered hedgerows, and especially those overhung with trees. Its general habitat is very similar to that of another charming plant, the foxglove, and the large size and rich colour of its blossoms tend to make it very conspicuous. Anyone who has at all studied the matter will have been struck by the comparative rarity of blue or purple flowers in our flora, yellow, white, and pink being the prevailing colours; and it is no doubt partly on this account that we, even involuntarily, admire the more the soft turquoise-blue of the forget-me-not, the deeper blue of the germander speedwell, or the rich empurpled azure of the wild hyacinth. One old name of the flower is the Canterbury-bell. It is difficult to see why the name of this particular place should be so identified with the plant. On turning to Prior's most valuable work on "The Popular Names of British Plants," we find that he says, "So named by Gerarde, from growing very plentifully in the low woods about Canterbury." On turning to the old herbalist's pages to verify this, it does not in any way appear that Gerarde himself bestowed the name. He simply states that the plant "growes very plentifully in the low woods and hedgerowes of Kent, about Canterbury, Sittingbourne, Gravesend, Southfleet, and Greenehyth"; but he also records it as occurring at Greenwich, and "in most of the pastures about Watford and Bushey, fifteene miles from London." All these

localities are in the districts that a man like Gerarde, a resident in the metropolis, might be expected to know well.

The Life of a Butterfly.

A small red-and-black butterfly poises statuesque above the purple blossom of this tall field-thistle. With its long sucker it probes industriously floret after floret of the crowded head, and extracts from each its wee drop of buried nectar. As it stands just at present, the dull outer sides of its four wings are alone displayed, so that it does not form a conspicuous mark for passing birds; but when it has drank up the last drop of honey from the thistle flower, and flits joyously away to seek another purple mass of the same sort, it will open its red-spotted vans in the sunlight, and will then show itself off as one among the prettiest of our native insects. Each thistle-head consists of some two hundred separate little bell-shaped blossoms, crowded together for the sake of conspicuousness into a single group, just as the blossoms of the lilac or the syringa are crowded into larger though less dense clusters; and, as each separate floret has a nectary of its own, the bee or butterfly who lights upon the compound flower-group can busy himself for a minute or two in getting at the various drops of honey without the necessity for any further change of position than that of revolving upon its own axis. Hence these composite flowers are great favourites with all insects whose suckers are long enough to reach the bottom of their slender tubes.

The butterfly's view of life is doubtless on the whole a cheerful one. Yet his existence must be something so nearly mechanical that we probably overrate the amount of enjoyment which he derives from flitting about so airily among the flowers, and passing his days in the unbroken amusement of sucking liquid honey. Subjectively viewed, the butterfly is not a high order of insect: his nervous system does not show that provision for comparatively spontaneous thought and action which we find in the more intelligent orders, like the flies, bees, ants, and wasps. His nerves are all frittered away in little separate ganglia distributed among the various segments of his body, instead of being governed by a single great central organ, or brain, whose business it always is to correlate and co-ordinate complex external impressions. This shows that the butterfly's movements are almost all automatic, or simply dependent upon immediate external stimulants; he has not even that small capacity for deliberation and spontaneous initiative which belong to his relation the bee. He is, as it were, but a piece of half-conscious mechanism, answering immediately to impulses from without, just as the thermometer answers to varia-

tions of temperature, and as the telegraphic indicator answers to each making and breaking of the electric current.

In early life the future butterfly emerges from the egg as a caterpillar. At once his legs begin to move, and the caterpillar moves forward by their motion. The caterpillar walks, it knows not why, but simply because it has to walk. When it reaches a fit place for feeding, which differs according to the nature of the particular larva, it feeds automatically. After a considerable span of life spent in feeding and walking about in search of more food, the caterpillar one day found itself compelled by an inner monitor to alter its habits. Why it knew not; but just as a tired child sinks into sleep, the gorged and full-fed caterpillar sank peacefully into a dormant state. Then its tissues melted one by one into a kind of organic pap, and its outer skin hardened into a chrysalis. Within that solid case new limbs and organs began to grow by hereditary impulses. At length one day the chrysalis bursts asunder, and the insect emerges to view a full-fledged and beautiful butterfly.

For a minute or two it stands and waits till the air it breathes has filled out its wings, and till the warmth and sunlight have given it strength. For the wings are by origin a part of the breathing apparatus, and they require to be plimmed by the air before the insect can take to flight. Then, as it grows more accustomed to its new life, the hereditary impulse causes it to spread its vans abroad, and it flies. Soon a flower catches its eye, and the bright mass of colour attracts it irresistibly, as the candle-light attracts the eye of a child a few weeks old. It sets off towards the patch of red or yellow, probably not knowing beforehand that this is the visible symbol of food for it, but merely guided by the blind habit of its race, imprinted with binding force in the very constitution of its body. Thus, the moths, which fly by night and visit only white flowers whose corollas still shine out in the twilight, are so irresistibly led on by the external stimulus of light from a candle falling upon their eyes that they cannot choose but move their wings rapidly in that direction; and though singed and blinded twice or three times by the flame, must still wheel and eddy into it, till at last they perish in the scorching blaze. Their instincts, or, to put it more clearly, their simple nervous mechanism, though admirably adapted to their natural circumstances, cannot be equally adapted to such artificial objects as wax candles. The butterfly in like manner is attracted automatically by the colour of his proper flowers, and, settling upon them, sucks up their honey instinctively. But feeding is not now his only object in life; he has to find and pair with a suitable mate. That,

indeed, is the great end of his winged existence. Here again his simple nervous system stands him in good stead. The picture of his kind is, as it were, imprinted on his little brain, and he knows his own mates the moment he sees them, just as intuitively as he knows the flowers upon which he must feed. Now we see the reason for the butterfly's large optic centres: they have to guide it in all its movements. In like manner, and by a like mechanism, the female butterfly or moth selects the right spot for laying her eggs, which of course depends entirely upon the nature of the young caterpillars' proper food. It may light on one flower rather than another; it may choose a fresher and brighter mate rather than a battered and dingy one; but its little subjectivity is a mere shadow compared with ours, and it hardly deserves to be considered as more than a semi-conscious machine.

An Earwig Trap.

If the dried, hollow stems of the common hemlock be cut into pieces a few inches long and placed among fruit-trees, the earwigs, which would otherwise remain concealed amongst the fruit, will congregate in them, as many as thirty being sometimes found in a single stem. They may be killed by blowing out into a bowl of boiling or soapy water, a little soap in the water ensuring their drowning rapidly.

Answers to Queries.

297.—Hydroidæ.—To preserve them with extended tentacles they should be plunged in cold fresh water, which kills them so quickly that these are not often retracted. It has been also stated that the best method of killing zoophytes is to drop alcohol, French brandy, or benzole into the salt water in which they are placed, as this will cause no retraction of the tentacles if it be done gradually. The specimens should be preserved in spirit until there is leisure to prepare them. Many of the zoophytes are well preserved by mounting in cells with Goadby's fluid or distilled water, with the addition of a little camphor, carbolic acid, or other preservative. For examination by polarised light, however, they are usually mounted in balsam, while those in cells present a more

natural appearance as to position, etc., for common study. Many operators speak well of distilled water, well shaken with a few drops of creosote, as before mentioned. If balsam is used, the specimens must be transferred from the spirit to clove-oil before mounting. The "exposure" method, described in our last, will be found useful for partially hardening the balsam.

A contributor to *Science Gossip* (1884, p. 194) gives a somewhat different method :—"Such marine forms as *Sertularia* or the *Corynidæ* may be arranged in a cell in their native fluid, under a covering glass ; when fully expanded, and in vigorous action, pure alcohol from the tip of a sable pencil is allowed to run under the cover. It immediately kills the creature, and, although not successful in every case, generally they are paralysed and die before retraction. The cell is then closed with the ordinary cements. For experiment, the freshwater polyzoon, *Sophobus*, is always available ; it takes to alcohol very kindly. A group of three or four should be arranged in a ring of glass under the cover, and when the horse-shoe tentacles are fully expanded the stimulant is cautiously admitted, and generally a fair and permanent preparation secured." G. H. BRYAN.

297.—Hydroidæ.—I hear that a solution of cocaine has been successfully used to stupefy (before killing) minute marine animals, having the effect of leaving the tentacles expanded. Try this.

B.Sc., Plymouth.

298.—Snail.—These are generally killed by being plunged into boiling water. This answers very well if the palates are required, and as the body is hardened slightly by the process, this will be an advantage in dissecting out the eyes. If it is found that the animal is still too soft, it may be left in alcohol for some time.

G. H. B.

299.—Iron.—The surface of this should be lacquered with a solution of shellac in spirit. Ordinary shellac contains certain ingredients which are not perfectly soluble in alcohol, and these must first be separated by filtering the solution through a cone of blotting-paper. A *thin* coating is applied to the metal and allowed to dry. Bleached or white shellac is best for the purpose. G. H. B.

299.—Varnish for Polished Iron or Steel.—The following is taken from that very useful book, "Spon's Workshop Receipts": "Varnishes for Polished Metal.—1.—Take bleached shellac, pounded in a mortar ; place the bruised fragments into a bottle of alcohol, until some shellac remains undissolved ; agitate the bottle and contents frequently, and let the whole stand till clear. Pour off the clear fluid. This forms the varnish. Warm the metal surface, and coat with a camel-hair brush. If not perfectly transparent, warm the varnished surface before a fire or in an oven

until it becomes clear. Common orange shellac answers equally well, and for large surfaces even better, as it is more soluble than the bleached variety, and coats more perfectly, but care must be taken not to use the varnish insufficiently diluted. 2.—Digest one part of bruised copal in two parts of absolute alcohol; but as this varnish dries too quickly, it is preferable to take one part of copal, one part of oil of rosemary, and two or three parts of absolute alcohol. This gives a clear varnish as limpid as water. It should be applied hot, and when dry it will be found hard and durable. 3.—Mix equal quantities of Canada balsam with very clear spirits of turpentine, until the whole is of the consistency of ordinary varnish, which can be determined by constantly shaking and allowing to settle. This may be applied without warming the varnish or metal." Some one of these three should prevent bright steel and iron from rusting when exposed occasionally to the fumes of gases. H. W. Lett, M.A.

299.—Iron.—To keep from rusting in the presence of occasional noxious fumes, brush over with a thin paste of powdered glass in a concentrated solution of silicate of soda.

B.Sc., Plymouth.

300.—Photography.—Marion's 1s. book on the subject is a very good elementary one. If a fuller and more complete account is required, get Captain Abney's work. G. H. B.

300.—Photography.—The best cheap work on dry-plate photography is "Burton's A B C of Modern Photography," price 1s. After "M. B." has mastered that, I would recommend Eder's "Modern Dry Plates," price 3s., or Captain Abney's "Instruction in Photography," also 3s. B.Sc., Plymouth.

301.—Indian Yellow.—The analysis of three samples showed the following average:—Organic colouring matter (probably turmeric or saffron), 19·4 per cent.); chalk, 80·6 per cent.

B.Sc., Plymouth.

301.—Indian Yellow.—The water-colour pigment known as Indian yellow is described in a book in my possession as composed of magnesia and euxanthic acid, but no description is given of the mode of preparation. H. W. Lett, M.A.

302.—Coloured Confectionery.—Turmeric and gamboge are not much used, if at all, in colouring confectionery. Saffron is the colouring matter in common use. If J. N. D. is going to experiment in confectionery, he should purchase the "Confectioner's Handbook," by E. Skuse. B.Sc., Plymouth.

303.—Magenta.—These colours are poisonous. Fuchsine or magenta is prepared from aniline by combination with bichloride

of tin and roseine from sulphate of aniline by combination with binoxide of lead. I have not heard of anyone being poisoned with these colours, but I for one would not feel comfortable were I to drink a solution of either the lead or the tin compound.

B.Sc., Plymouth.

304.—Palmyra, or zebra wood, or palm wood, is, as the name implies, the wood of a palm tree, *Borassus flabelliformis*.

B.Sc., Plymouth.

304.—Palmyra Wood.—Palmyra wood is the wood of a species of palm, *Borassus flabelliformis*, having a straight, black, upright trunk with palmate leaves. It is indigenous to the northern shores of the Indian ocean from the Tigris to New Guinea. Native writers of India enumerate more than eight hundred uses to which the tree and its varied products are put. Among these may be mentioned its timber, which is largely used for building houses; its fruit and roots, both of which serve for food; its sap, which is full of sugar and is made into the drink called toddy; while its broad leaves are the common thatch of the huts of the country. H. W. Lett, M.A.

305.—Campanularia volubilis.—Place in a mixture of equal parts of sublimate and picro-sulphuric acid for ten minutes. Then wash in 35 per cent. and 70 per cent. alcohol; mount in a shallow cell (these are now to be got as a part of the glass slide at most dealers), and try the new medium, celloidin.

B.Sc., Plymouth.

305.—Campanularia and Insects' Eggs.—For the method of mounting the former, see answer to Query 297, which will here apply. Specimens of insects' eggs are easily prepared and mounted for the cabinet, the only difficulty being to destroy vitality without spoiling their beauty. Immersion in alcohol, touching each with a hot needle, has been suggested; but a dip in water just under the boiling point is effectual, and in some cases improves their appearance. Before mounting they must be carefully dried. Opalescent or irridiscent eggs are seen to the best advantage empty, as mere shells, after the larvæ have escaped. This especially applies to the eggs of parasites attached to hairs or feathers. The eggs are mounted in a dry, opaque cell.

G. H. B.

305.—Campanularia volubilis.—If the specimen of *Campanularia volubilis* is dead, I should mount it dry as an opaque object, either for the spot-lens or in a blackened cell for the one-inch or two-inch objective. It should be well soaked in distilled water, and if freshly boiled all the better, and thoroughly washed in severl waters to get rid of every trace of salt, etc., and then dried

so that no trace of moisture remains in it, before being fastened in the cell. When it can be procured in a living state, it can be killed with the tentacles expanded by the gradual introduction of a minute quantity of alcohol into the water in which it is. It can then be mounted in a cell in some of the same fluid, first placing in the cell a drop of a 100 per cent. solution of carbolic acid and water.

Insects' Eggs are best seen when mounted dry in a cell just as is done with the larger species of foraminifera. They should, of course, be subjected to a process of thorough dessication without heat before the cover-glass is cemented on, or they will soon be spoiled for ever by a crop of mould. H. W. Lett, M.A

306.—Spines of Echinus.—The best way of preparing a section of an Echinus spine for examination of its minute structure is to cut a number of sections of the spine about the thirty-second part of an inch thick, with a fine saw, which can be easily constructed out of a piece of thin clock-spring. Then fasten a number of these sections with hardened Canada balsam to a glass slip, and rub on a smooth hone-stone with water till a polished face is obtained. The sections—now half wrought—are next thoroughly cleaned with water, and when quite dry each is to be transferred separately to balsam on the slide, and placed the smooth side next the glass in the position in which it is to be finished. The finishing consists in rubbing down the section on the hone-stone till, by observing it with the microscope, it is found sufficiently thin, when it is to be thoroughly washed with water and alcohol, dried, and mounted with benzole and balsam. There are full directions given in Carpenter on "The Microscope." They are too long to be quoted here, but they should be studied, particularly what he says about the proper consistence of the Canada balsam. The operation is by no means a difficult one, and the results are well worth the trouble. H. W. Lett, M.A.

306.—Spines of Echinus.—To mount these, I would glue the spine, as it were, to a glass slide with the rosin and wax composition (10 parts to 1); when cool, file to near the centre with a watchmaker's flat file; polish with a small slip of Water-of-Ayr whetstone. Wash, dry, then heat and turn the section; proceed as before, until the section pleases for thinness. Wash with a slight stream of water and a camel-hairbrush, dry thoroughly, put on cover-glass with a drop of Canada balsam in chloroform, clamp with wire clamp, and lay aside in sunshine, if possible, to harden.

B.Sc., Plymouth.

Mounting Opaque Objects in Balsam.—Mr. Ward's paper is in the *Northern Microscopist*, vol. III., p. 197, not the *Journal of Microscopy*, as stated in my note on p. 185. G. H. B.

Queries.

All Questions and Answers should be clearly and concisely written on one side of the paper only, and every question or answer must bear the name and address of the writer. If this is written on the left-hand bottom corner, it will not be published, in which case initials or other signature should appear in the usual place. When more than one answer is sent by the same correspondent, each must be written on a separate piece of paper.

Correspondents, in sending us answers to questions, are desired to commence by quoting the number and title of the question as printed, before beginning their replies.

307.—The Bread Fungus.—In a newspaper of September, 1883, I found the following paragraph under the above heading:—"The native bread-fungus of Australia is as large as a man's head, and when cut it has the appearance of rice pudding. It is very tasteless and insipid, though esteemed a great delicacy by the aborigines." Is this the same as what Dr. M. C. Cooke alludes to at p. 101 of "Fungi: Their Nature, Influence, and Uses," where he says:—"A large species of *Mylitta*, sometimes several inches in diameter, occurs plentifully in some parts of Australia"? Or what is it? and where can I find any further account of it? or, better still, would some correspondent be good enough to write to the editor what is known concerning it? H. W. Lett, M.A.

308.—Pond Larvæ.—Large quantities of red, thread-like worms are often found, towards the end of the summer, near the surface of the water, in ponds, They probably turn into some kind of fly, and if so, what kind, and what is the name? There is also a phantom-like larva often to be seen in pond-water. Does this turn into a stone-fly? Is there any work published on this particular subject (the larva of the ponds)? One often comes across such funny little creatures, which must, I think, begin their life in the water and finish them on the land upon the wing, like the gnat, caddis fly, May-fly, etc. M. A. Henty.

309.—Earwigs.—Can anyone give any reason why there has been such a plague of earwigs in the south of Hertfordshire for the last two years, but especially the last year? M. A. Henty.

310.—Corpuscles.—How can the Pacinian corpuscles and Hassell's be best demonstrated? Histo.

311.—German Histological Terms.—Will V. A. L. or any other correspondent be so good as to explain the following, viz.:—*Epitelioma* conjunctivæ mit *kern*figuren; *kerntheilungs*figuren? Information is desired in respect of the words in italics. A. S. G.

312.—Staining Blood.—What is the best way to stain and mount preparations of human blood? Plasma.

313.—Mounting Micro Fungi.—Will any reader kindly give the most usual way of mounting *Æcidium compositus*, etc. etc.?

FUNGI.

314.—Zoology.—Will any reader kindly help by informing me how to proceed to classify animals? I have gone through some elementary zoology and now fail, as I get confused in the genera, species, etc., and the books vary so. Nicholson and Marshall are my usual books. BEGINNER.

315.—Papier-Mache Models.—How can the "*papier-mache*" figures to illustrate the brains of animals and insects be made? I remember once reading an account in the *Quckett Journal* or *Science Gossip*, but cannot now refer to it. I should much like to know. E. L.

316.—Olfactory Mucous Membrane.—I should much like to know how to prepare sections of the olfactory mucous membrane, etc. A. L.

Correspondence.

To the Editor of the "Scientific Enquirer."

DEAR SIR,—A year or two before 1871 I met at S. Leonard's a Mr. Aldous, who told me he was engaged in making the microscopic drawings for Dr. Bowerbanks' work on sponges, and on my entering into conversation with him he also informed me of experiments he had made on taking microscopic mountings of *people's breath* in some way, by which he was enabled to draw the crystals, etc., so obtained, and to be able to inform them of any latent sources of disease which they might be harbouring unawares. I obtained from him a series of such drawings, and asked him how he had been enabled to make them; but he replied that he had kept the secret, which would probably be made known at his death, and that although members of microscopical societies had come to him wishing to gain information on the subject, he had not made known to them the way, as he wished to make money out of his discovery. He was then over eighty years of age, a very hale old man, with remarkably keen sight, but it is hardly to be expected that he is living now. I have the drawings by me still, and I should be glad to hear whether anyone else ever heard of this supposed discovery, and whether, if it was real and *bona fide*, it has yet been revealed? (REV.) L. B. BARTLEET.

72 Warleigh Road, Brighton.

Reviews.

La Photographique appliquée a la Production du Type D'une Famille, D'une Tribu ou D'une Race. Par Arthur Batut. Fscap 4to, pp. 23. (Paris: Gauthier Villars. 1887.)

Mons. Batut has in this treatise carried still further Mr. Galton's experiments of combining several photographs to form one which shall so unite the features as to give a result which will be the average of the whole. He gives us two experimental illustrations, in which two series of photographs are thus combined, and the result is, to say the least, very interesting.

Notes sur l'Histoire de la Photographie Astronomique. Par M. G. Rayet, Directeur de l'Observatoire de Bordeaux. Royal 8vo, pp. 64. (Paris: Gauthier-Villars. 1887.)

This brochure, from the observatory of M. G. Rayet, of Bordeaux, gives a good *resumé* of the progress of photographic astronomy, which, in view of the great use that is now being made of photography in fixing the position of the stars, cannot but be of great value.

La Photographie Pratique: Manuel a l'usage des Officiers, des Explarateurs, et des Touristes. Par le Commandant E. Joly. Crown 8vo, pp. 59. (Paris: Gauthier-Villars. 1887.)

This is a thoroughly practical treatise on photography as a piece of manipulation. It does not attempt to go into the theories of the various chemical changes, but it tells the operator (especially the operator in the field) what he ought to do and what should be left undone, and points out the causes of failure and indicates the remedies. It deals with the production both of positive and negative photography, but naturally gives prominence to the latter.

Traite Pratique de Gravure sur Verre par les Procédés Héliographiques. Par Geymet. Crown 8vo, pp. 172. (Paris: Gauthier-Villars. 1887.)

In this book the author, commencing with the composition of glass, gives us the details necessary for the production of engravings on glass, either plain or coloured. He also gives a valuable paper on the metallic oxides and other preparations which are used to produce coloured glass.

Manuel Pratique de Photographie Instantanee. Par A. Agle. Crown 8vo, pp. 155. (Paris: Gauthier-Villars. 1887.)

The author points out in this treatise the special difficulties which arise when really instantaneous photography is practised. The work before us is not addressed to the tyro, but to those who, having mastered the initial difficulties, are desirous of practising the highest department of the art, and to such we believe that Mons. Agle's book will prove a real pleasure.

Photographie Isochromatique: Noveaux procédés pour la Reproduction des Tableaux, Aquarelles, etc.; Applications au Collodion et au Gélatinobromure d'Argent, de l'Eosine, de la Rosaniline, de la Chlorophyll, du Curcuma, etc. Par V. Roux. Crown 8vo, pp. 36. (Paris: Gauthier-Villars. 1887.)

The reproduction of works of art by means of photography has always been one of its weak points. The chemical action of the various colours has little or no reference to their optical effects. Thus, yellow, which often gives us the high lights of a picture or landscape, is almost inert so far as the sensitive plate is concerned; anything, therefore, which points out a method of remedying this defect is a boon, and Mons. Roux shows us that there are several bodies which, when added to photographic collodion, make it much

more sensitive to these inert chemical rays; and thus, when applied to the reproduction of paintings in oil or water colours, give results approaching more nearly to correct reproductions of the original.

THE A B C GUIDE to the Making of Autotype Prints in Permanent Pigments. By J. R. Sawyer, Director of the Autotype Works. Fscap. 4to, pp. xiv. 98. (London: The Autotype Company. 1887.) Price 2s. 6d.

Six editions of the "Autotype Manual" having been exhausted, the volume before us has been entirely remodelled, and explains the working of the autotypes processes in a more simple form, and with special reference to new and improved methods. In the introductory chapter we have a short sketch of the history of autotypes. This is followed by pages devoted to a description of the tissues, giving their colours and characteristics, with the general principles upon which the operations are based. The whole process is very fully described, and, as we are told that the autotype processes are not hampered by patents or restrictions of any kind, any person is at liberty to use them without let or hindrance. A beautiful example of permanent autotype photography forms a frontispiece to the volume. Another plate of larger size shows the printing process in operation.

THE PHOTOGRAPHER'S INDISPENSABLE HANDBOOK: A Complete Cyclopædia of the subject of Photographic Apparatus, Material, and Processes. Compiled by W. D. Welford and edited by Henry Sturmey. 8vo, pp. 379. (London: Iliffe and Son. 1887.) Price 2s. 6d.

In the work before us appears in a very exhaustive manner every description of photographic apparatus. It is divided into ten sections, in which will be found catalogued and described cameras, lenses, tripods and stands, apparatus used before exposure, shutters, complete sets, materials, apparatus used after exposure, enlarging apparatus, and general articles and information. Whether or not every photographer will find the handbook "indispensable," we think they will do well to possess a copy.

PRACTICAL AMATEUR PHOTOGRAPHY. By C. C. Vevers, author of "Dry-Plate Photography," "Successful Photography," etc. Post 8vo, pp. 50. (Published by the author, Horsforth, Leeds. 1887.) Price 6d.

This is a useful little text-book for the beginner. It is divided into two parts. Part I. is written for those who are thoroughly unacquainted with the mysteries of photography, and describes in the plainest manner the processes of taking, developing, and finishing a photograph. Part II. is more advanced, and contains many alternative formulæ and other information for those who have mastered the rudiments of the process.

PHOTOGRAPHIC PRINTING METHODS: A Practical Guide to the Professional and Amateur Worker. By Rev. W. H. Burbank, 8vo, pp. 221. (New York: The Scoville Manufacturing Company. 1887.)

In the work before us the author gives us in a simple and practical way a large amount of information and formulas connected with photographic prints. The book is divided into 17 chapters. Many of the subjects will doubtless prove of much value to the practical photographer—*e.g.*, we find chapters dealing with carbon prints, printing on fabrics, enlargements, transparencies and lantern slides, opal and porcelain printing, photo-mechanical printing methods, etc. etc. The pictorial illustrations are very good, the frontispiece being a photo-gravure; a bromide print faces page 65.

THE AMERICAN ANNUAL OF PHOTOGRAPHY. Second edition, Edited by C. W. Cassfield. 8vo, pp. 296. (New York: Scoville Manufacturing Company. 1887.)

Contains a large amount of useful information and several very excellent plates

A Text-Book of Algebra. By W. Steadman Aldis, M.A., University College, Auckland, New Zealand. Crown 8vo, pp. xiii.—588. (Oxford: Clarendon Press; London: Henry Frowde. 1887.) Price 7s. 6d.

The author tells us that this book is the outcome of lectures delivered to the students in the College of Physical Science at Newcastle-on-Tyne. We are pleased with the manner in which the introductory chapters are dealt with, because it is our experience that many pupils fail to make proper progress owing to faulty instruction in *first principles.* Those who are looking for a really clear and logical text-book in algebra, and one also well printed and got up, will find in this book what they want. The chapters on permutation, ratio, and proportion are specially interesting, and place the different matters treated of in the most advantageous manner. While the advanced classes of schools and colleges will find this a useful book, private students will glean important assistance from its pages. The first eight chapters are in themselves a valuable treatise.

Gymnastic Exercises without Apparatus, according to Ling's System for the Due Development and Strengthening of the Human Body. By Dr. Mathias Roth. 8vo, pp. 56. (London: A. N. Myers and Co. 1887.)

An exposition of Dr. Ling's system is here given, illustrated by numerous figures, showing the different attitudes to be adopted in training. If the instructions here given were followed, much good would undoubtedly be the result, and we think that a small daily portion of each pupil's school-time might be very profitably employed by these exercises.

Parental Commandments: A Warning to Parents on the Physical, Intellectual, and Moral Training of their Children. (London: Walter Scott. 1887.) Price 6d.

This little book might have been called the "Parental Don't," each sentence beginning with that word. It is divided into two parts, the first referring to the physical, intellectual, and moral qualities in children; the second to hygiene, infancy, and home.

First Year of Scientific Knowledge. By Paul Bert; translated by Josephina Clayton. Fifth edition. 12mo, pp. 344. (London: Relfe Bros. 1887.) Price 2s. 6d.

We gladly welcome a fifth edition of this capital little book, which treats of a very large number of subjects, embracing Animals, Plants, Stones and Soils, Physics, Chemistry, Animal Physiology, and Vegetable Physiology. It contains 550 illustrations.

Pupil-Teacher's Geographical Year-Book. Third year. Crown 8vo, pp. 58, and 10 maps. (Edinburgh and London: W. and A. K. Johnstone. 1887.) Price 2s. 6d.

This is the third of Messrs. W. and A. K. Johnstone's valuable series of geographical year-books, and treats of Asia and Africa, each country being described under two sections; Section A—Physical and General, in which is shown the position, boundaries, and political divisions, coast-line, relief and drainage, climate and products, races and population, religion, etc.; Section B treats of the Geography of Particular Countries. The amount of information contained in these little books is considerable.

The Earth in Space: A Manual of Astronomical Geography. By Edward P. Jackson, A.M. 16mo, pp. 73. (Boston, U.S.A.: D. C. Heath and Co. 1887.)

This is a condensed and simplified version of a much larger work entitled "Mathematical Geography." It is well suited for school use, is well printed, and illustrated with 31 engravings.

The Student's Handbook to the Microscope: A Practical Guide to its Selection and Management. By a Quekett Clubman. Crown 8vo, pp. 72. (London: Roper and Drowley. 1887.) Price 2s. 6d.

This book at first sight conveys the impression that it has a little too much of the trade catalogue about it. A number of illustrations of first, second, and third class microscopes are given, the instruments being fully described and prices quoted. In addition to this, much information is given as to the use and manner of utilising the various accessories; then follows a list of books helpful to the microscopist.

Elementary Practical Biology: Vegetable. By Thomas W. Shore, M.D., B.Sc.Lond. 8vo, pp. viii.—173. (London: J. and A. Churchill. 1887.)

This work is the outcome of the author's three years' courses of instructions in Botany at St. Bartholomew's Hospital, and differs somewhat from other text-books on the subject. The introductory chapter treats of Apparatus, Preparation of Vegetable Tissues, Imbedding, Section Cutting, Staining, Preparation of and Mounting Sections, Preparation of Reagents, and General Directions. Part I. treats of General Vegetable Morphology; Part II., Cryptogamia; Part III., Phanerogamia-Gymnospermia; and Part IV., Angiospermia. The instruction given in all cases is exceedingly concise. We cordially recommend the book.

Cardboard Designs for Forming Geometrical Models.

Cardboard Designs for Constructing a Terrestrial Globe. (London: A. N. Myers and Co.)

Two packets of designs, from which a clever boy may derive both instruction and amusement.

The Booke of Olde Manchester and Salford. Small 4to, pp. 136. (Manchester: John Heywood. 1887.) Price 2s. 6d.

Describes old Manchester as seen in the Royal Jubilee Exhibition now being held at Manchester. It is well got up on old-fashioned paper, and the descriptions and illustrations are good.

Friend MacDonald. By Max O'Rell. (Bristol: Arrowsmith. (London: Simpkin, Marshall, and Co. 1887.) Price 1s.

A collection of very amusing anecdotic recollections of the Land o' Cakes, told by the author in his best style.

A Complete Catalogue of British Mollusca, compiled from Jeffrey's "British Conchology," with alterations and additions to date. By Charles Jeffreys. (Gloucester: Herbert W. Marsden. 1887.) Price 1s. 3d. Postage, 1d. extra.

This catalogue will be found most useful to the collector, it being thoroughly classified, and as the pages are printed on one side of the paper only it may be used for labelling a collection. In the above catalogue, land, fresh-water, and marine specimens are named. We have also received a catalogue of Land and Fresh-water Mollusca, which is published at 4d., or free by post 4½d.

Our American Cousins; being Personal Impressions of the People and Institutions of the United States. By W. E. Adams. Crown 8vo, paper covers, pp. xii.—357 and appendix xxiii.

In these pages the writer gives an interesting account of what he heard in America. *The New York Herald* says of this book:—"The author brings to

his work acute penetration, a keen observation, a graphic and picturesque style of presenting his impressions, and a quiet humour that finds expression in quoting amusing scraps from newspaper stories and sayings that aptly illustrate the case in point." Those who wish to know more about our American friends should read this book.

The Cambridge Examiner, with Questions for Oxford Students. (London: Samuel Baxter and Sons, Limited. September and October, 1887.)

Contains a series of examination papers, embracing subjects required for the Cambridge and Oxford Junior and Senior Local Examinations, issued monthly except July and August. Students preparing for examination will be considerably helped by a study of these questions, all of which appear to be very carefully prepared and well adapted to put the pupil on the right road for posting himself up in the different branches of his study. For a small fee, students' papers will be corrected and explained by the examiners, among whom we notice several names well known in the scholastic world.

Answers to Correspondents.

F. R. B.—We do not think it advisable to reprint the article you allude to at present.

Book-Buyer.—You should get a copy of Mr. W. P. Collins's last Catalogue of New and Second-hand Books; it is an unusually large one, and is almost sure to contain what you require.

F. W. Clarke.—Many thanks for your kind remarks.

Sale and Exchange Column.

[All Exchange Notices are inserted free; for Notices of Books or Scientific Instruments or Accessories offered for sale, a charge of 4d. for the first 12 words and 1d. for every succeeding 3 words will be made.]

Diatom Deposit, cleaned, sufficient for 100 slides, in exchange for 3 good Diatom Slides.—F.R.M.S., Mottram, Manchester.

Wanted, Wings of Lepidoptera (foreign preferred), suitable for micro mounting, in exchange for other objects.—J. W. Wilshaw, 455 Shoreham St., Sheffield.

Microscope Objects—Anatomical, Botanical, Insect parts, Crystals, Diatoms, Zoophytes, Foraminifera, Minerals, etc., 6d. each, 5s. dozen. List, approval.—Henry Ebbage, 165 Hagley Road, Birmingham.

Wanted, Six Dozen Microscope Slides. Exchange, Scientific Recreations, cost 11s., and Cassell's Science for All, 4 vols., 5th and last now issuing, cost 39s.—Henry Ebbage, 165 Hagley Road, Birmingham.

For Sale or Exchange.—100 correctly-named and localised Rocks and Fossils.—J. B. Bessell, 8 Elm-Grove Road, Bristol.

Microscopical Slips, Thin Covers, Media, Cements, etc., 33 kinds of Labels; samples, 2d. *Unmounted Objects*, as fine Polariscopic Horn and Hoof Sections, Insects, Zoophytes, brilliant selected Show Objects from Exotic Lepidoptera, etc.—Chas. Watkins, King's Mill House, Painswick, Gloucestershire.

Worked Flints, Paleolithic and Neolithic, in exchange for Fossils.—Apply to J. French, Felstead, Essex.

High-class Injections from Monkey, consisting of lip, tongue, liver, lung, spleen, finger. The six slides for 5s.—Henry Vial, Crediton, Devon.

The Scientific Enquirer.

DECEMBER, 1887.

To our Readers.

DEAR FRIENDS,—

With feelings of deep regret, and by command of my medical adviser, I have to inform you that owing to the state of my health I am obliged to discontinue the publication of THE SCIENTIFIC ENQUIRER with the present issue.

In this number I have made a special effort to furnish Answers to a long array of Queries which up to the present appear to have escaped the notice of some of our contributors. I have also made arrangements with a number of specialists to furnish answers to all questions of a scientific nature, which may at any time be sent to me. The Questions and Answers will appear together in THE JOURNAL OF MICROSCOPY AND NATURAL SCIENCE, to which I beg you will in future transfer your subscriptions.

A new series of THE JOURNAL OF MICROSCOPY AND NATURAL SCIENCE will be commenced on January 1st, 1888, in which it is believed many improvements will be found, and several new departments will be opened.

Very sincerely thanking you for all favours,

I am, yours faithfully,

ALFRED ALLEN,

Editor.

The Clearwing Moths.

Of all our moths, the *Lesidæ* are the most elegant, graceful, and fairylike. Unlike almost all other moths, they fly in sunshine, and nothing can exceed the grace and beauty of their motions, as they hover over a flower or walk over its petals or leaves, gently waving their transparent or sylph-like wings. Almost every character by which we distinguish large divisions has its

exceptions, and although we have said that moths are nocturnal, we have here a family of moths that are true lovers of sunshine. They constitute the exception to the rule. The most remarkable character of these moths is this:—They seem to have no similarity at all to other moths, but rather resemble gnats and bees and wasps and a host of other insects. Their antennæ are rather long and rather thickest beyond the middle, and in the males they are what is called slightly ciliated—that is, they have a row of very short bristles all along one side, very short indeed, so short as hardly to be seen without a magnifying glass. The wings are narrow and transparent, the body long, and bordered with white, yellow, orange, or bright-red belts, and they generally have a tuft of hairs at the tail, which is spread out like a fan when the insect is hovering over a flower. The legs are long and hang down like those of a gnat when the insect is flying. Our young readers are requested to observe that in our description of these moths we say nothing about the hind wings because they are all so much alike, quite transparent with black rays and black margin.

Mounting without Pressure.

Where insect or other objects are mounted in a deep cell of fluid, they are apt to slip to one side of the cell if the slide is placed in a vertical or even sloping position. To prevent this, Mr. Enock holds them in place by means of a fine hair or thread of spun glass stretched across the cell, and this does not materially detract from the appearance of the slide.

Answers to Queries.

172.—**Distribution of Atmospheric Pressure.**—If a region of low pressure occurs round each pole on the isobarometric chart referred to by S. G. M., it must be purely imaginary, as no means exist which give the data for such lines. Probably the chart is one of isothermal lines, because, so far as we know, the average cold there is very intense. B.Sc., Plymouth.

174.—**Geology.**—The best book to read in advanced stage is Geikie's. B.Sc., Plymouth.

174.—**Geology.**—The best books for the purpose are Sir Charles Lyell's "Principles of Geology," Prof. J. Phillips's "Manual of Geology," or if a less expensive work is required, Ralph Tate's "Class-Book of Geology." G. H. B.

177.—**Sugar-Ant.**—Those on the spot will be better able to suggest a remedy, as here we have no means of experimenting. Have you tried paraffin oil? B.Sc., Plymouth.

178.—How to Prepare Head of Gnat.—The method to be adopted must depend on how the object is to be viewed. Thus, if it is required to view the head as an opaque object, showing the organs in their natural form and colour, the whole may be mounted without pressure, in a sufficiently deep cell filled with carbolised water (distilled water containing a drop or two of carbolic acid), after having been previously soaked in this medium for a week or more. If it be required as a more transparent object, it should be mounted in glycerine in the same way, as this will render the appendages sufficiently transparent. In either case a thread of fine-spun glass should be stretched across the cell to hold the head in place. But for examination of the structure of the antennæ, labium, and piercing organs, the head may be mounted in balsam under pressure in the usual way—viz., it should be soaked in dilute caustic potash, washed in acidulated water, laid on a piece of glass in a drop of this, and pressed flat with another piece of glass on the top. This pressure will in almost every case cause the organs to protrude and separate as required. It is then tied up between the glasses, soaked in spirit, then in clove oil, and mounted in balsam, without being dried at any stage of the process. Drying would render it impossible to separate the parts, and therefore must be avoided, and the success of the operation in this respect depends mainly on the organs being well spread out when the pressure is first applied. The object may be floated out of the spirit on to a thin cover, and the clove oil dropped on it in this position, followed by balsam.

G. H. B.

178.—How to Prepare Head of Gnat.—To do this you will require good tools—viz., a dissecting microscope, two fine needles, two fine dissecting knives, scissors, and forceps. Then comes practice, but do not be discouraged, for you cannot expect to do at first that which is difficult to those who have had years of practice.

B.Sc., Plymouth.

179.– Mounting Insect Organs.—Why not use liquor potassæ? I am aware that many microscopists object to it on the ground that it destroys some of the finer internal structure, but this could be exhibited by sections of the parts far better than by "whole mounts," and I have never found nor heard of any medium that will produce the transparency and clearness obtained with liquor potassæ; moreover, it is very universally used both by professionals or amateurs. In mounting the tongue of the bee, the whole head at least should be soaked in the potash, even if the tongue is then removed, as otherwise it will be very difficult to spread the tongue out, and in the case of the Blow-fly this is absolutely necessary, as the lobes of the proboscis can only be

expanded by pressure on the head. The sting of the bee should be dissected out with the poison-bag and duct attached. It may be safely left in a weak solution of caustic potash for a few days, washed and stained with aqueous solution of aniline blue, then soaked in acidulated water, spirit, and clove oil (five minutes each), placed in balsam on the cover, exposed for two days, and mounted. My own specimen was obtained in a very curious way. I felt something crawling on my hand one day, and on shaking it off found that a bee had left its sting, with poison-bag and all, on my hand, without stinging me! G. H. B.

179.—Mounting Insect Organs.—Try soaking in potass and mounting in dammar thinned with chloroform; but recollect that the slides bought from opticians are produced by men who have served an apprenticeship to slide-work. B.Sc., Plymouth.

179.—Mounting Insect Organs.—If the stings and tongues of bees, etc., are well moistened with water and placed in liquor potassæ, they will in a few days become clear and transparent, and can then be mounted in either Canada balsam or glycerine jelly. I have whole heads of honey-bees so prepared and mounted in both mediums without pressure—of course, in sufficiently deep cells—that are most interesting objects of study.

H. W. Lett, M.A.

180.—Best Illumination for Stephanoceros.—This query is extremely vague and incomprehensible. I find the best illumination for high powers to be an Argand gas or paraffin lamp, with blue shade and condenser. B.Sc., Plymouth.

183.—Photographic Plate Varnish.—What is a "stereotype negative photographic plate"? If you mean a negative which has been used for one of the many photo-printing processes, varnish it by all means with common negative varnish.

B.Sc., Plymouth.

184.—Plant Crystals.—I have a slide of the peel of the onion, mounted in a mixture of spirit and water, in an asphalt cell, about seven years ago, and it shows the raphides just as well as when fresh. Would not this, or camphor, or carbolised water, answer the purpose? Oxalate of lime is *very insoluble* in water, although *carbonate* of lime is soluble in glycerine, yet I believe this is not the case with oxalate, as I have several times kept raphides in it for some months. The great drawback to the use of Deane's medium is that most compounds sold under this name contain more or less glycerine; but if my surmise is correct this objection would cease to exist. I regret not being more positive on this point. G. H. B.

185.—India Rubber.—The best cement for this is a solution of

caoutchouc in bisulphide of carbon containing 8 per cent. of absolute alcohol, but the better way is to get a new tobacco-pouch.

G. H. B.

186.—India Rubber.—Cut the torn edges with sharp scissors, and quickly press together; nothing else is required.

B.Sc., Plymouth.

191.—Tinning Rusty Iron.—The best way of removing the rust would be by means of weak sulphuric or hydrochloric acid, especially the former, but it must be remembered that they will attack the iron also. G. H. B.

191.—Tinning Rusty Iron.—A very rusty piece of iron, which it is required to tin, must first be thoroughly cleansed, either by scouring or filing off the rust, or burning it off with strong acid.

H. W. Lett, M.A.

194.—Oxygen from Air.—If any experiments have been made for separating oxygen and nitrogen from air by means of dialysis or osmose, an account of them will probably be found in the *Journal of the Chemical Society* or the *Chemical Trade Journal* (see No. 1174). Possibly the querist refers to a new process discovered in France, but not yet published or patented here.

B.Sc., Plymouth.

198.—Diatomaceæ.—The chemical action of the different acids and alkalies used in cleaning *Diatomaceæ* will be found on reference to any of the elementary treatises on chemistry at present in use, and may be summed up in this:—The object of cleaning is to clear away all matter from the diatoms except the siliceous (flinty) framework, or rather covering. B.Sc., Plymouth.

198.—Diatomaceæ.—The action of nitric acid in cleaning these is that of oxidation of the organic matter contained in the material. Nitric acid parts very readily with part of the oxygen contained in it, and is reduced to nitrous acid, a gas which manifests itself in the form of reddish-brown fumes, which are very poisonous, while the oxygen combines with the carbon and hydrogen in the organic matter, forming "carbonic acid" (carbon dioxide) and water. The nitric acid will also dissolve carbonate of lime if present, but hydrochloric acid does this still better. If the sulphuric acid and chlorate of potash process is used, the acid, which has a violent affinity for water, removes from the organic matter (cellulose, etc.) all the hydrogen and oxygen, which are present in the right proportion to form water, and leaves nothing behind but the carbon, as is seen by the blackening of the material. When the chlorate is dropped in, the sulphuric acid combines with the potash, setting free the chlorine and oxygen; the latter combines with the carbon, which is thus, so to speak, burnt up, while the chlorine bleaches any organic matter which may

remain. The alkalies—such as liquor ammoniæ—form a soluble sort of soapy compound with any flocculent matter that may be left; but it is dangerous to use potash or soda, as they are apt to act on the silica, which it is required to preserve. G. H. B.

199.—Arranging Diatoms.—Use any microscope you possess with a 1-inch objective. Arrange them on the cover (not the slide), previously coated thinly with white shellac, lifting them up with a thread of spun glass; heat the cover thoroughly, cool and mount, turning over the cover to a drop of heated balsam on the slide. B.Sc., Plymouth.

199.—Arranging Diatoms.—If it be required to group these in *patterns*, a "mechanical finger" must be used, though equally *useful* slides may be made with a fine hair or thread of spun glass fixed in a wooden handle. The patterns are in the first instance drawn with paint on the mirror of the microscope, and an image of them formed on the slide by means of a powerful condenser placed under the stage. This serves as a guide in averaging the objects. The great advantage of a binocular microscope is that it saves fatigue to the eyes. For selecting delicate forms, as Pleurosigmas, which cannot be taken off the slide without damage—a drop of water should be placed on one side of the cover, containing a few valves, then pushed into a group in the centre of the cover, and what are not wanted wiped away. G. H. B.

200.—Dry Rot in Wood.—The mycelium most common in Britain producing dry rot is *Merulius lachrymans.* Thorough ventilation will not arrest its progress unless the affected parts are all taken away. Where a floor is affected, I cure by first cutting away all affected parts; second, thorough ventilation under; and third, put on ground a layer of soap waste. New wood put in should be "Kyanised"—*i.e.*, in corrosive sublimate solution forced into the pores of the wood by an air pump. B.Sc., Plymouth.

200.—Dry Rot in Wood.—Very little is known of the life-history of the fungus *Merulius lachrymans*, *Fr.*, which is the common dry rot of wood. When once it has got hold of the timber of floors ventilation is of no use to arrest its progress. Nothing avails but to put in a new floor. But ventilation under the joists is the best preventive of this destructive plant.

H. W. Lett, M.A.

201.—Mites in Cheese.—Dr. George has demonstrated that mites are a very large family and almost ubiquitous. Hence I find no difficulty in understanding how a cheese in course of time may come to be the home of one, who there founds a mighty colony. The papers I refer to have appeared in our P.M.S. Note-Books, in *The Journal of Microscopy and Natural Science*, and in *Science Gossip.* H. W. Lett, M.A.

205.—Aperture Shutter.—The use of this is to diminish the breadth of the pencils of light transmitted by an objective of wide angle, in order to obtain greater "depth of focus." Wide-angled objectives are required for resolving fine markings on diatoms and for bringing out the forms of bacilli, etc., and are absolutely necessary when it is wanted to obtain a clear and distinct representation of the minutest details. But in histological work it is sometimes more necessary to see distinctly portions of a section slightly above or below those points accurately in focus. This property, known as "penetration," diminishes as the aperture is increased, for which reason the shutter is used to diminish the aperture of the objective, and obtain greater "penetration" at the expense of resolving power. Cheap objectives of low aperture do not require this to be done. G. H. B.

207.—Micro-Spectroscope.—I daresay it is quite possible to get up an instrument on the basis of the sugar spectroscope for examining microscopic spectra, but I have not yet heard of its achievement. B.Sc., Plymouth.

211.—Remounting Slides.—You may remount amyloid degeneration in any of the usual ways, but do not expect to see the amyloid degeneration. At least, that is my experience.
B.Sc., Plymouth.

211.—Remounting Slides.—Scrape off as much as possible of the cement with an old knife. Then put the slide in a shallow dish, just cover it with water or some of the medium, and proceed to break the cover off by pushing a needle or knife-blade under its edge, taking care not to injure the section. The performance of the whole process under the liquid will prevent the section from being curled up, and, if it will bear heat, warming the slide or using warm water will often cause the cover to separate more readily. The section must now be transferred to some more of the medium, floated into a fresh cell on a clean slide, and mounted in the usual way. G. H. B.

212.—Eggs of Insects.—A liquid that will preserve insect-eggs without change of colour or form is unknown. Mount them dry.
B.Sc., Plymouth.

215.—Collecting Marine Animals.—There can be no better way of bringing these home than in the sea-water in which they are found. If it is required to bring them back dead, they may be killed by plunging into fresh water and bottled either in sea-water or in Goadby's fluid (No. 2). This consists of bay-salt, 4 ounces; alum, 2 oz.; corrosive sublimate, 4 grains: distilled water, 2 quarts. G. H. B.

215.—Collecting Marine Animals.—For a preserving fluid try Professor Fol's method. Take an alcoholic solution of perchloride of iron, dilute with water to 2 per cent., then pour on the animals, when they sink to the bottom pour off and add alcohol at 70 per cent., pour off and repeat the dose, adding a few drops of sulphuric acid to remove all traces of iron. B.Sc., Plymouth.

225.—Silvering Brass or Copper Tubes.—There is nothing to hinder tubes of the size given (20 centimetres diameter) being silvered by the galvanic process, but it would occupy too much space to describe in these pages. Buy a text-book on the subject. The length of time the silvering would last will entirely depend on the thickness of the coating. B.Sc., Plymouth.

225.—To Silver Brass or Copper Tubes.—Let the copper be immersed in a weak solution of nitrate of silver (in this case poured into the tube), and connect the two poles of the battery with the metal and with an electrode of silver immersed in the liquid, the positive pole being attached to the silver. The current will cause the silver to be dissolved from the electrode and deposited on the copper. This principle is employed in measuring the total current, passing through any galvanic circuit by an instrument called the voltameter, the whole flow of electricity being estimated by the quantity of silver transferred from one electrode to another. G. H. B.

232.—Sieve Tubes.—If you are satisfied your specimen is abnormal, send it to Professor de Bary, Strasburg. He is most obliging, and will tell you all about it. B.Sc., Plymouth.

235.—Spiders.—If required for the cabinet, they must be dried over a lamp, the body being kept inflated with hot air, in the same way as is done with larvæ, and which will be found described in *Science Gossip*, Vol. XIX., p. 35 (Feb., 1883), by W. Finch, jun. But another very convenient way of preserving them is in small specimen-tubes filled with alcohol (methylated spirit). They must, however, be killed with chloroform or benzine or other poison first, otherwise they will continue to live for some hours in the spirit, and *even* from a collector's point of view this is bad, as they are apt to damage themselves in their struggles.

For the microscope, legs, palpi, jaws, etc., may be mounted under pressure in the same way as parts of insects, and the eyes may, when dried, be mounted *in situ* on the head in a dry opaque cell. But a far better plan is to mount them without pressure in carbolised water, the head being held transfixed by a fine glass thread. As the eyes are examined opaque, a suitable dark background should be made. For this purpose slips of black glass are very good, or the under side of the slide should have a patch

of asphalt painted beneath the cell. I have seen beautiful slides of spiders' eyes thus mounted by amateurs, rivalling even Enock's famous slides. The structure of spiders can best be made out by hardening them, cutting sections through the body from head to tail with a microtome, and staining them. G. H. B.

239.—Mounting Sections of Seeds.—I find the simplest method to be as follows:—Cut the seed in as dry a state as possible; then immerse the cutting in turpentine for twenty-four hours; then mount in dammar dissolved in turpentine. B.Sc., Plymouth.

239.—Mounting Sections of Seeds.—Glycerine jelly is about the best medium for mounting sections of seeds. The sections must be cut very thin, and they should be transferred direct from the blade of the cutter to the glass slip on which they are to be mounted. Any kind of preparation is sure to displace some of the envelopes or layers of tissues, and in all the smaller seeds a freezing microtome is indispensable. H. W. Lett, M.A.

240.—Paraffin and Chloroform (Bütschli's formula).—I would read the troublesome formula as follows:—Heat paraffin wax to the melting point, and pour it into chloroform kept at 35° until no more will dissolve. Decant or filter. B.Sc., Plymouth.

246.—Mounting without Pressure.—The specimens may be bleached by soaking in a solution consisting of 10 drops of hydrochloric acid, ½ dram chlorate of potash, 1 oz. water. In this they should be left for a day or two, and when transparent well washed, or a solution of sodium hypochlorite may be used, being prepared as follows:—Take 2 oz. fresh bleaching powder (chloride of lime), and dissolve in 1 pint of distilled water, add saturated solution of washing soda till no further precipitate occurs, filter and keep in well-stoppered bottles in the dark, but always make fresh when possible. I may mention that I have slides of *Neuroptera*, showing the tracheal system very distinctly, even after soaking in caustic potash. G. H. B.

246.—Mounting without Pressure.—Heads of insects are rendered sufficiently transparent to enable their internal structure to be exhibited, when mounted without pressure, by simply keeping them in liquor potassæ and water till they become clear enough. More or less water is to be added to the potass according as the part of the insect is hard or soft, which is also the rule for the length of time the steeping is to be continued.

H. W. Lett, M.A.

248.—Aquaria.—There are shilling manuals on Aquaria, which give all particulars as to cleaning, etc. B.Sc., Plymouth.

248.—Aquarium.—Taylor's book of the "Aquarium" will tell all about the cleaning and stocking of one. I strongly recommend T. B. to purchase it. H. W. Lett, M.A.

249.—Mounting Dried Insects.—The only way one can tell if your fragments can be mounted would be to see them. Try it yourself, or show them to an entomologist. B.Sc., Plymouth.

249.—Mounting Dried Insects.—By treating with liquor potassæ, slides may be obtained showing the external structure nearly if not quite as well as those mounted from specimens kept in alcohol. This is a very good way of making use of damaged specimens which are useless for the cabinet. I have a very good slide of the head of a cicada, mounted from a broken specimen from a collection of Australian insects given me. G. H. B.

249.—Mounting Dried Insects, etc.—It is possible to mount insects that have become dried after death, by soaking them in boiling water, and then bleaching them so far as is desired with liquor potassæ and mounting in the usual way in glycerine jelly or Canada balsam; but such never make as satisfactory mounts as those preserved in spirit from their death. H. W. Lett, M.A.

250.—Lemna.—I know of nothing better than the descriptions of and information about the British Lemnas contained in Hooker's "Student's Flora" and Bentham's "British Flora."
H. W. Lett, M.A.

253.—Japanner's Gold Size.—Gold size which deposits a sediment in the bottle in which it is kept is of inferior quality and perfectly useless for any microscopical purpose. Throw it away and buy a fresh bottle. H. W. Lett, M.A.

260.—Pure Tin Cells with Caps or Covers may be obtained from Thos. D. Russell, 78 Newgate St., E.C. G. H. B.

267.—To Find Truffles.—Although dogs are trained in France to detect various species of truffle, it is doubtful whether they would be able to find the English species. The *Tuber æstivum*, or British truffle, is frequently found projecting above the soil, and can then be readily detected. G. H. B.

270.—Thawing Green Vegetables.—J. B. states that if hot water is used, the vegetables "become disagreeable and even poisonous when cooked," and asks "what chemical change takes place when they (vegetables) are thawed in hot water?" Possibly there may be something in the sudden change of temperature closing up and as it were putting a skin on the vegetable, which may hinder exudation and make the vegetable strong-flavoured, but as for poisoning or chemical change I do not believe it. B.Sc., Plymouth.

271.—Preservation of Flowers without Pressing.—Lay them out on a blot sheet, arrange them in their natural shapes, and put them on a shelf where there is a current of air. Vegetables are dried in this manner for the market, but the current of air is forced by steam or water power. B.Sc., Plymouth.

271.—Preservation of Flowers.—Flowers may be dried so as to preserve their natural form and, to a great extent, colour by placing them in a tin box, covering them with sand, and leaving the whole for some hours, or a day, in a *cool* oven or on the plate-rack of an ordinary kitchener. Another recipe is to use a mixture of plaster of Paris and powdered chalk instead of the sand, but I do not know the exact proportions. The great difficulty is to avoid breaking the specimens in removing them from the sand. The flowers of the common ox-eye daisy (*Chrysanthemum leucanthemum*) are especially satisfactory examples of the method. When thus dried, they come in very usefully as winter decorations, if placed in flower-vases with dried ferns, etc. Baking in hot sand is also invaluable in drying specimens of the succulent *Crassulaceæ*, which will spoil, or even grow, in an ordinary collecting press. G. H. B.

272.—Micro Fungi.—Many cannot be permanently mounted. For many of those that can be mounted, De Bary uses for medium carbolic acid solution 1 to 5 per cent. The "parts to use" are the propagating or multiplying. B.Sc., Plymouth.

272.—Micro Fungi.—In my answer to Query No. 313 will be found the way to mount these as *opaque* objects. The telentospores of various species of *Puccinia*, *Phragmidium*, *Triphragmium ulmariæ*, the rare *Xenodochus carbonarias*, and others, form very interesting objects, if mounted in balsam as follows:—Remove some of the black or brown mass on the point of a knife, and deposit it in the centre of the slide or cover in a drop of turpentine. This will separate the spores. Now put balsam all round, which will spread inwards and bring the spores towards the centre. The slide may be covered and left to dry, or the cover exposed to harden the balsam, a plan which has the further advantage that the spores all settle on the surface of the cover-glass. Others mount the telentospores in glycerine jelly. For this method and other information on mounting fungi generally, I would refer to a paper by C. F. W. T. Williams, B.A., in *Science Gossip*, Vol. XV., p. 3 (Jan., 1879), G. H. B.

272.—Micro Fungi.—Many of the micro fungi are best shown by making a section of a very small portion with a razor and mounting in glycerine jelly. Others, such as *Trichias* and *Phragmidiums*, can be mounted by taking a small portion on the point of a knife and placing at once on the glass slip, and covering in the ordinary way. But it would be a heavy task to "give full directions for the mounting of fungi," and quite beyond the room that could be spared to the subject. H. W. Lett, M.A.

273.—Water-Glass Cement.—This is undoubtedly the silicate of either potassium or sodium. It may be prepared as follows:—

Boil in a clean iron ladle 2 drachms of powdered flint with 4 drachms of caustic potash and 2 oz. of water for some hours, supplying fresh water occasionally as the other evaporates; then let the mixture stand in a corked bottle to settle. The silica dissolves in the potash, and forms with it a thick fluid—potassium silicate; or one part of flint powder may be fused with 4 parts of dry sodium carbonate (common washing soda) in a crucible over the fire. The soda soon commences to effervesce from the escape of carbonic anhydride (carbon dioxide), which is replaced by the silicic anhydride. The mass, on being boiled with water and filtered, furnishes a solution of sodium silicate. To prepare the flint powder, heat a common flint stone in the fire, and when it is red hot quench it in cold water. The sudden cooling so influences and diminishes the internal cohesion that now the flint can easily be reduced to a fine white powder. These solutions, which are sometimes known as *liquor silicum*, have been sometimes used as microscopic mounting media for starches and other vegetable objects, but little seems to have been said on their merits in this respect. They are recommended in Nave's "Collector's Handy Book" for mounting leaves of mosses, etc. See also Stockhardt and Heaton's "Experimental Chemistry," from which the above method is taken. G. H. B.

273.—Water-Glass Cement.—Water-glass is silicate of soda, and is used as an acid-proof cement, mixed to a paste with fine ground glass. I am afraid, however, that its adhesiveness is not strong enough for mending broken glass. For this purpose it must be mixed with casein (skim-milk cheese) as follows:—Wash the casein until no longer acid. Fill a bottle with this in a damp state to a quarter of its height. Then fill up with water-glass and shake frequently till the casein is dissolved. B.Sc., Plymouth.

281.—Gum Tragacanth for Insect-Mounting.—V. asks, "What are its advantages over balsam?" I don't know of any. To keep it good and free from mould, add 2 drops of carbolic acid per oz. B.Sc., Plymouth.

281.—Gum Tragacanth for Insect-Mounting.—This is used for mounting (setting) small beetles and small insects on card as cabinet specimens, not as microscopic objects, for which it would be too cloudy. It is also used for mending broken limbs of insects. It forms with water a stiff, jelly-like paste, but is somewhat intractable. Therefore, I prefer a solution of ordinary gum arabic, containing a trace of glycerine. G. H. B.

290.—Pond-Life Collecting.—This subject requires a volume. Buy "Cooke's Ponds and Ditches," 2s. 6d. B.Sc., Plymouth.

291.—Sections of Equisetaceæ.—The best method of preparing sections of equisetums so as to keep all the parts unmoved in

their proper position, is to cut them with a freezing microtome, such as Cathcart's, and transfer them direct from the blade of the cutter to the glass slip, and mount at once without disturbing the various rings of tissue. H. W. LETT, M.A.

296.—Test-Objects.—For ¼ to ⅛ *Pleurosigma angulatum*, for immersion *Surirella gemma* or *Navicula rhomboides*, and for all, Nobert's lines. B.Sc., Plymouth.

308.—Pond Larvæ.—The red thread-like worms may be the larvæ of a species of gnat, but the description is too vague for identification. The phantom-like larvæ is probably that of *Corethra plumicornis* (the plumed gnat). Dr. M. C. Cooke's little book on "Ponds and Ditches" (London : S.P.C.K., price 2s. 6d.) contains much interesting information on aquatic larvæ and other inhabitants of ponds. G. H. B.

309.—Earwigs.—The abundance of these, which has been very general during the past year, is doubtless due, in great measure, to the exceptional dryness of the season. G. H. B.

309.—Earwigs.—My experience of earwigs is that they are as numerous one year as another. I have lived during the last thirty years in the counties Antrim, Armagh, and Down, and have always noticed earwigs to abound during summer and autumn. They will be found in greater numbers in flower-gardens than elsewhere because they are vegetable-feeders and delight in such delicacies as the tender-growing tips of plants and their unexpanded flower-buds. I also find them in and about my bee-hives, where they congregate for warmth, but I have proved by experiment that they do not touch the honey or annoy the bees.

H. W. LETT, M.A.

310.—Corpuscles.—The Pacinian bodies or corpuscles are only got in the human body, with great trouble, by preparation of the skin-nerves of the palms of the hands or the soles of the feet. The usual method of observation is to make a preparation from the mesentery of a cat. Diluted acetic acid shows them well. For preservation, diluted chromic acid or chromic and bichromate solution are used. To break up the capsule use very sharp needles and a dissecting microscope or a good magnifying glass. Hassall's concentric bodies of the thymus gland are of an epithelian character, and are observed by drying. Vertical sections and caustic potash solution. Fine cuts and "teased" preparations of the fresh gland are also necessary for observation.

B.Sc., Plymouth.

311.—German Histological Terms.—*Epitelioma* means a cancerous condition of the epithelium or skin of a mucous surface. *Kern* (the cherrystone, plumstone, etc.), in this case, the nucleus. *Kerntheilungsfiguren*, nucleus division figures. B.Sc., Plymouth.

311.—German Histological Terms.—*Epitelioma*, a cancerous tumour, with large development of epithelial cells; *kern*, nucleus; *kerntheilung*, subdivision of nucleus. The sentence refers to a drawing of conjunctive epithelium, in which the nuclei are figured in the process of subdividing. G. H. B.

312.—Staining Blood can be done with aniline red, but it is useless. The best form in which blood can be preserved for the collection is the dry one. Take a drop (from the hand or arm by a needle puncture) on a slide and dry immediately, when dry, cover, and ring with cement. B.Sc., Plymouth.

313.—Mounting Micro Fungi.—The species of *Æcidium* and many other genera are best viewed when mounted dry as opaque objects. The leaves, with the fungi *in situ*, should be thoroughly dried under gentle pressure between the leaves of a book or in a collecting press, and then a portion of the right size should be cut from the leaf and fixed to the bottom of a suitable cell. Wooden slides, perforated in the centre, are very convenient for the purpose. A slip of card, with a black patch in the middle, should be attached to the back of the slip, forming a suitable background, and, if desired, a cover of thin glass fastened down over the aperture in front. Most people fix the latter on with a ring of varnish round the edge, but there could be no worse plan, for if moisture or any impurity should settle on the under surface of the cover it cannot be removed without breaking. This difficulty may be obviated in several ways. One is by taking four tiny pieces of bent wire, and driving the ends into the wood at points symmetrically around the aperture. These act as clips and hold the cover down, while the latter may be removed by turning them round, cleaned and replaced. A still simpler plan is to take one of the ornamental paper-covering labels and fasten it on the slide with gum at either end, leaving an inch square in the centre not stuck down. The thin glass may be slipped underneath this, and at any time be slipped out, cleaned, and put back, or replaced by a clean cover. For examining the minute structure of *Æcidium*, sections must be prepared and stained, a matter of some difficulty. It seems to me that all that is necessary with the commoner kinds of parasitic fungi—leaves, plant-hairs, and similar microscopic objects—is to keep them in small paper packets, whence they may be readily taken out and examined under the microscope without the trouble and cost of mounting. G. H. B.

313.—Mounting Micro Fungi.—The fungus, *Æcidium compositarium*, can be mounted either as a dry opaque object in a cell, which makes a very nice object, or by making a thin transverse section through the middle of the cluster of peridiums, and then mounting it either in Canada balsam or glycerine jelly.

H. W. Lett, M.A.

315.—Papier-Mache Models.—I have a note that, in *Science Gossip* for 1879, p. 103, is an interesting description of the mode of preparing models of brains, etc., of insects. The example given is that of the cockroach. Not having the volume at hand, I cannot check this mem., but send this, as the reference may help your correspondent. W. E. G.

315.—Papier-Mache Models are made in exactly the same method as plaster casts :—First, a model is made by hand ; from that a mould ; and from the mould as many copies as may be desired. B.Sc., Plymouth.

315.—Papier-Mache Models.—The paper to which E. L. alludes is by E. T. Newton, E.G.S., on "A New Method of Preparing a Dissected Model of an Insect's Brain from Microscopical Sections." It was read before the Quekett Club on Jan. 24, 1879, and appeared in *Science Gossip*, Vol. XV., p. 103 (May, 1879). The number containing it may still be obtained from the publishers, and it would be impossible to describe at all Mr. Newton's method in an abstract. G. H. B.

316.—Olfactory Mucous Membrane.—This is not easy to prepare, especially if you wish to see the peculiarities of the region, viz.—the olfactory cells, with their thread-shaped ramifications and the endings of the olfactory nerve. Schultze has written a splendid monograph on the examination and preparation of this most difficult subject. All that I could say about it in the short space allotted to these replies would be useless except to show the difficulty and magnitude of the work you propose to undertake. B.Sc., Plymouth.

Reviews.

The Creator, and what we may know of the Method of Creation. By W. H. Dallinger, LL.D., F.RS., etc. 8vo, pp. 83. (London : T. Woolmer. 1887.) Price 2s. 6d.

This is the Fernley Lecture of 1887, and is, with the exception of some additional passages, printed as it was delivered. It addresses "thoughtful and earnest minds, not concerned specially with questions of philosophy, metaphysics, and science, but alive to the advanced knowledge and thought of our times, and anxious to know, so far as in such a form it could be expressed, how the great foundation of religious belief, the existence of Deity, is affected by the splendid advance of our knowledge of nature." It is a most carefully written discourse, and will unquestionably be read with profit by the thoughtful student.

The World's Inhabitants ; or Mankind, Animals, and Plants. By G. T. Bettany, M.A., B.Sc. Part I. 8vo, pp. 64. (London : Ward, Lock, and Co.) Price 6s.

This is a new and very fully-illustrated Monthly, published by Messrs. Ward & Lock. The part before us consists of Introduction ; The Early Inhabitants of the British Islands ; Historic Britons ; The Britons of To-day ; France in the Past ; and the Modern French. This part is also accompanied by a Chart (30 by 40 inches) of the Races and Populations of the Globe.

We have much pleasure in recommending this new series to the notice of our readers.

THE CAMBRIDGE EXAMINER.—We regret that in our last notice of this useful little paper, we made a mistake in the name of its publishers, which should have been Samuel Bagster & Sons, Ltd., 15 Paternoster Row, London.

A CHAPTER in the Early History of Phonography. By Thomas A. Reed, with a Preface by Eizak Pitman. 12mo, pp. 80. (London: Pitman and Sons. 1887.)

Mr. Reed describes in a cheerful manner some of the difficulties and encouragements he met with in his early endeavours to promote the Study of Phonography.

THE PHONETIC TEACHER: a Guide to a Practical Aquaintance with the Art of Phonography or Phonetic Shorthand. By Isaac Pitman and Sons. 1887. Price 6s.

This is the Jubilee edition of the "Teacher," and we think that we can say nothing more in favour of Pitman's system of phonography than that, no less a number than ONE MILLION ONE HUNDRED AND THIRTY THOUSAND copies of this work have been printed.

Sale and Exchange Column.

[All Exchange Notices are inserted free; for Notices of Books or Scientific Instruments or Accessories offered for sale, a charge of 4d. for the first 12 words and 1d. for every succeeding 3 words will be made.]

Wanted.—Diatomaceous Earth from Mejillones, Bolivia, South America; can give in exchange either Diatomaceous Earth from Oamaru, New Zealand, or cash.—E. Michalek, Fleischmarkt, No. 1, Wien, I. Austria.

Micro Slides (over 300) offered in exchange for any Books or Scientific Apparatus.—A. Downes, 5 Royal Park Road, Clifton, Bristol.

Microscope Objects, 6d. each, 5s. dozen. Approval. Large selection. Write for list.—Henry Ebbage, 165 Hagley Road, Birmingham.

Science Gossip for 1881 and *Naturalist's World* for 1884 in exchange for Botanical Micro Slides.—J. Boyd, Dean's Bridge, Armagh.

Diatom Deposit, cleaned, sufficient for 100 slides, in exchange for 3 good Diatom Slides.—F.R.M.S., Mottram, Manchester.

Wanted, Wings of Lepidoptera (foreign preferred), suitable for micro mounting, in exchange for other objects.—J. W. Wilshaw, 455 Shoreham St., Sheffield.

Microscope Objects—Anatomical, Botanical, Insect parts, Crystals, Diatoms, Zoophytes, Foraminifera, Minerals, etc., 6d. each, 5s. dozen. List, approval.—Henry Ebbage, 165 Hagley Road, Birmingham.

Wanted, Six Dozen Microscope Slides. Exchange, Scientific Recreations, cost 11s., and Cassell's Science for All, 4 vols., 5th and last now issuing, cost 39s.—Henry Ebbage, 165 Hagley Road, Birmingham.

For Sale or Exchange.—100 correctly-named and localised Rocks and Fossils.—J. B. Bessell, 8 Elm-Grove Road, Bristol.

Microscopical Slips, Thin Covers, Media, Cements, etc., 33 kinds of Labels; samples, 2d. *Unmounted Objects*, as fine Polariscopic Horn and Hoof Sections, Insects, Zoophytes, brilliant selected Show Objects from Exotic Lepidoptera, etc.—Chas. Watkins, King's Mill House, Painswick, Gloucestershire.

Worked Flints, Paleolithic and Neolithic, in exchange for Fossils.—Apply to J. French, Felstead, Essex.

High-class Injections from Monkey, consisting of lip, tongue, liver, lung, spleen, finger. The six slides for 5s.—Henry Vial, Crediton, Devon.

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REVIEWS.

JANUARY, 1887. Vol. II., No. 1.

THE SCIENTIFIC ENQUIRER:

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Scientific Subjects.

EDITED BY

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LONDON:

BAILLIERE, TINDALL & COX, KING WILLIAM ST., STRAND, W.C.

BATH: 17 CAMBRIDGE PLACE.

C. Seers, Printer, 1 Argyle Street, Bath.

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THE SCIENTIFIC ENQUIRER:

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Scientific Subjects.

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